

A Review of the Scientific Literature As It Pertains to Gulf War Illnesses

VOLUME 4

STRESS

Grant N. Marshall
Lois M. Davis
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with

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National Defense Research Institute

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PREFACE

This literature review, one of eight commissioned by the Special Assistant to the Deputy Secretary of Defense for Gulf War Illnesses, summarizes the existing scientific literature on the health effects of stress that may have affected military personnel who served in Operations Desert Shield and Desert Storm. The eight RAND reviews are intended to complement efforts by the Defense Department and other federal agencies in their attempt to understand the full range of health implications of service in that conflict.

Many veterans have reported an array of physical and mental health complaints since the war. Whether veterans are experiencing either higher-than-expected rates of identifiable illnesses with known etiologies or other illnesses from unidentified origins is not yet clear.

The other seven RAND literature reviews deal with chemical and biological warfare agents, depleted uranium, pesticides, pyridostigmine bromide, immunizations, oil well fires, and infectious diseases. These represent plausible causes of some of the illnesses Gulf War veterans have reported.

The reviews are intended principally to summarize the scientific literature on the known health effects of given exposures to these risk factors. Where available evidence permits, the reviews also summarize what is known about the range of actual exposures in the Gulf and assess the plausibility of the risk factor at hand as a cause of illnesses. Statements related to the Gulf War experience should be regarded as suggestive rather than definitive, for more research on health effects and exposures remains to be completed before definitive statements can be made. Recommendations for additional research where appropriate are included.

These reviews are limited to literature published or accepted for publication in peer-reviewed journals, books, government publications, and conference proceedings. Unpublished information was occasionally used, but only to develop hypotheses.

This work is sponsored by the Office of the Special Assistant and was carried out jointly by RAND Health's Center for Military Health Policy Research and the Forces and Resources Policy Center of the National Defense Research Institute. The latter is a federally funded research and development center sponsored by the Office of the Secretary of Defense, the Joint Staff, the unified commands, and the defense agencies.

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SUMMARY

OVERVIEW

Between August 1990 and July 1991, approximately 697,000 U.S. active-duty and reserve-component unit personnel served in the Persian Gulf theater in Operations Desert Shield and Desert Storm. For a significant portion of these individuals, the Gulf War experience—before, during, and after deployment—was psychologically stressful. In the years following their service in the Gulf, veterans have suffered from a range of health problems.

This study is one of a series of RAND reports that examine evidence relating to the possible link between exposure to a host of conditions and exposures experienced by U.S. military participants in that conflict and Gulf War illnesses.

This paper evaluates the available evidence concerning the link between stress and health problems in general, and the role of stress in the health problems experienced by Gulf War veterans in particular. The general scientific literature indicates that stress can have myriad health consequences, although no single health problem or set of symptoms is distinctively characteristic solely of stress, with the exception of posttraumatic stress disorder.

THE PROBLEM

Given the large scale of the deployment, the war against Iraq was successfully prosecuted with comparatively little injury or loss of life to U.S. forces. Nonetheless, in the months and years following the end of the war, U.S. personnel reported health problems, many of which were attributed by the veterans to their service in the Gulf War. To date, no single cause of these health problems has been identified. Multiple contributing causes have been suggested, including exposure to chemical and biological weapons, depleted uranium, exposure to harsh climatic conditions, smoke from oil well fires, pesticides, insect repellents, reactions to prophylactic drugs (e.g., pyridostigmine

bromide) and vaccines, infectious diseases, and the psychological stresses of warfare.

Health problems can stem from either disease or illness. While disease and illness overlap, they are distinct constructs. Disease refers to constellations of symptoms that define a diagnosable physical or psychiatric disorder; illness refers to the subjective experience of poor health. Illness manifests itself as somatic (bodily) or psychological symptoms, but may stem from multiple sources—including cognitive and social processes—and may or may not reflect the presence of an underlying disease. The relationship of illness to disease is complex. A person may experience ill health with no underlying disease. Conversely, the person may suffer from an underlying disease without perceiving himself or herself as ill.

In certain circumstances and for certain individuals, stressful experiences can contribute to health problems. For the purpose of this review, we define stress as a real or perceived imbalance between environmental demands required for survival and an individual's capacity to adapt to these requirements. Circumstances that individuals perceive as stressful trigger an integrated series of responses—physiological, behavioral, and psychological—to adapt to the environmental demands. Although these responses may have short-term benefits, over time they may act in concert with other host and environmental risk factors to increase the likelihood of psychological or somatic symptoms.

Physiological mechanisms implicated in illness and disease include the autonomic nervous system and neuroendocrine mediators that influence immune, gastrointestinal, neuromuscular, and cardiovascular reactions. Acute activation of these systems is known to precipitate short-term adaptive changes (e.g., rapid heart rate, increased perspiration, gastrointestinal motility) that may be experienced as symptomatic of ill health. Chronic activation of these systems is believed to enhance vulnerability to cardiovascular, metabolic, immune-related, and other diseases. Behavioral responses to stress can also heighten risk of illness. Individuals under stress are more likely to engage in behaviors with significant ramifications for health, including poor eating and sleeping habits and consumption of alcohol and other substances. Psychological mechanisms have been implicated as influencing health in at least two ways. First, patterns of thinking about oneself and one's world may place individuals at heightened risk for various forms of psychopathology, including depression and anxiety. Second, under stress, psychological factors may heighten an individual's perception of himself or herself as sick.

HOW WE STUDIED THE PROBLEM

This study involved a wide-ranging literature review. We identified relevant literature through an extensive examination of the research database, including searches of *Psychological Abstracts*, *MedLine*, and *Defense Technical Information Center*, as well as the PILOTS database compiled by the National Center for Posttraumatic Stress Disorder. We relied on three sources of evidence:

- general—i.e., non-Gulf War-related—scientific literature concerning the link between stress and health problems; we reviewed more than 250 articles, books, and technical reports examining laboratory and field-research studies
- available data concerning stresses faced by personnel deployed to the Persian Gulf; we assessed approximately 55 studies that attempted to measure veterans' exposure to stress by means of in-theater psychiatric evaluations or surveys conducted in-theater or following the war
- empirical studies bearing directly on the link between stress and health problems experienced by Gulf War veterans; we examined approximately 60 articles and technical reports.

STRESS IN WARTIME

Classic discussions of war-related stress have long recognized that the war zone is full of hardships and danger, many only secondarily related to combat (e.g., Grinker and Spiegel, 1945). More recent research has continued to document that war-zone deployment may be associated with a wide range of potential stressors. These additional stressors include not only combat exposure but also exposure to atrocities (e.g., horrific carnage or body mutilation) and seemingly low-level events such as separation from loved ones and exposure to harsh living conditions (e.g., difficult climatic conditions, lack of privacy, limited opportunity for recreation, or long work hours). War-zone stressors may include any other events or circumstances that foster a sense of personal disheartenment, discomfort, or demoralization.

STRESS IN THE GENERAL SCIENTIFIC LITERATURE

The general scientific literature provides evidence that exposure to stressful events—including combat or war-zone exposure—can contribute to psychological or bodily symptoms. Relatively common symptoms include depression, anxiety, fatigue, impaired memory and concentration, headaches, back and neck aches, gastrointestinal complaints, and breathing difficulty. More severe forms of mental illness, including posttraumatic stress disorder and depression,

also have been linked to stress. Although the onset of symptoms typically begins within days of exposure, a sizable minority of persons may experience either delayed onset or delayed reporting of symptoms. The temporal course of symptoms of stress exposure is highly variable. It is not uncommon for symptoms of psychological and bodily distress to persist for years. But, in many instances, what appears as delayed onset of symptoms may be more aptly characterized as delayed help-seeking.

The general literature indicates that stress may be associated with a range of illnesses and diseases, but evidence of this linkage varies across problems. Little definitive evidence indicates that the stress of combat or war-zone exposure per se contributes to actual physical disease, although a number of epidemiological studies suggest that such exposure is associated with greater prevalence of self-reported chronic health conditions, poorer self-ratings of health, and higher levels of help-seeking behavior.

Members of the military are not alone in self-reporting health complaints in the absence of objectively verifiable disease; the empirical literature reports this as relatively common in the general population. Some evidence suggests that stress exposure and perceived stress may contribute to both medical help-seeking behavior and the experience of oneself as ill, even in the absence of objective evidence of disease.

Finally, evidence in the general literature suggests that virtually no stressful event or set of stressful circumstances produces health problems in every exposed individual. Certain persons may be more vulnerable to the potentially negative health consequences of stress exposure by dint of genetic or biological predisposition, prior life experiences, or personal and social coping resources as well as other factors.

STRESS IN THE GULF WAR

Surveys conducted during and after the war suggest that substantial numbers of U.S. military personnel in the Gulf War found the experience to be stressful. Deployment to the Persian Gulf theater exposed combatants and noncombatants to a wide range of stressful circumstances as self-reported by veterans. This stress exposure varied across different phases of the deployment. While the shooting war was brief and brisk, it was preceded by an abrupt, rapid mobilization and a prolonged build-up phase characterized by high levels of stress in anticipation of impending conflict.

Although these exposures were not reported to be stressful by all personnel, large numbers reported experiencing moderate to high levels of perceived stress resulting from various experiences. These findings were consistent

across most studies and over time (e.g., two to three years following the Gulf War). The data were also consistent across male and female veterans, with few differences found in self-reported stress between the two groups.

In comparison to active-duty personnel, members of reserve component units—as a group—appear to have experienced somewhat higher levels of perceived stress, perhaps because of different expectations about military obligations, different levels of preparedness or training, or problems in the way they were utilized (e.g., units split apart and individual reservists assigned to other than their parent organization), among other factors.

What was stressful? As might be expected, actual combat topped the list. Other stressors included witnessing the death or disfigurement of American, coalition, or enemy forces, prolonged anticipation of the risk of serious injury or loss of life due to impending air and ground assaults, as well as to possible chemical-biological warfare and SCUD missile attacks. Iraq's past use of chemical and biological weapons heightened apprehension about possible attacks and raised concerns regarding the effectiveness of defensive suits. The possible side effects of required prophylactic drugs were also a concern. The media predicted that U.S. forces would suffer 20,000 to 50,000 casualties, further intensifying the pre-battle anticipatory stress. The threat of random SCUD missile attacks was theater-wide.

Low-level stressors came from many sources. Deployment itself was deemed stressful. The unexpected and rapid nature of the deployment created personal and family hardships, especially for members of reserve-component units. Once in theater, military personnel said they confronted a myriad of stress points: crowded or austere living conditions, long work days, a harsh climate, confinement to base camps with little opportunity for customary recreational outlets, separation from loved ones, and nearly total isolation from indigenous populations. Uncertainty about the length and nature of the mission compounded these hardships. Domestic worries, including concerns regarding separation from family and family-related problems, were another important source of stress reported by many Gulf War veterans.

A final source of stress reported by veterans stems from widespread and unrelenting concerns about the possible negative health effects of Gulf War service. Even before the war ended, efforts began to examine potential health problems associated with Gulf War service. Ambiguity concerning the origins of health problems reported by some Gulf War veterans continues to this day, with media accounts and conflicting reports contributing to an on-going, stress-provoking climate of distrust, recrimination, and suspicion of government cover-ups and obstruction.

STRESS IN THE GULF WAR-SPECIFIC SCIENTIFIC LITERATURE

In our review of some 60 Gulf-specific articles, we identified over 30 studies relevant to a possible link between stress exposure in the Gulf War and health problems experienced by returning veterans. Most measured either perceived stress or actual stress exposure, constructs which are not synonymous, in at least one of the following ways: (1) by using self-reports included in interviews or questionnaires, or (2) by identifying soldiers who experienced a potentially very stressful event (e.g., witnessing deaths from friendly fire, handling human remains). Virtually all studies measured health outcomes in terms of self-reported symptoms of psychological or bodily distress.

Gulf War and Posttraumatic Stress Disorder (PTSD). All fifteen studies that evaluated this relationship found evidence of a positive—albeit modest—relationship between stress exposure and PTSD symptoms. However, these studies were methodologically flawed. They relied on self-report measures or retrospective reporting of exposures, they contained little data from representative samples of deployed personnel, and they did not generally attempt to rule out other etiologic factors. As a result, these studies provide evidence—albeit suggestive—of a link between stress exposure and PTSD.

Gulf War and Non-PTSD Mental Health Problems. Ten studies reported on the relationship between stress exposure and other mental health problems. Although differing in numerous respects, including sample sizes and the operational definition of both stress exposure and mental health, most of these studies provided evidence of a relationship between stress exposure and psychological distress. These associations tended to be modest.

Like the PTSD studies, nearly all of these studies relied on veterans' self-reports of symptoms using symptom checklists, rather than diagnostic interviews. They also suffer from the same methodological problems. As a result, drawing definitive conclusions about the role of stress in non-PTSD mental health problems of Gulf War veterans is difficult.

Gulf War and Somatic Health Problems. Few studies were designed or reported in a manner that permit us to draw firm conclusions concerning the relationship between stress exposure and actual physical disease. We identified only four studies that directly report on the relationship between stress and bodily symptoms. These studies yielded mixed findings. In addition, they generally assessed physical symptoms using self-reports, which do not necessarily indicate an underlying organic cause and may merely reflect psychological distress. As a result, we found the Gulf War literature that evaluated a link between stress exposure and physical health to be quite limited.

CONCLUSIONS

In sum, a number of studies have examined the health effects of service in the Gulf War. Although these studies generally show that persons who went to the Gulf report more health problems than those who did not, they do not clarify whether these differences result from stress, other possible exposures, or preexisting conditions. With respect to specific health problems, the studies suggest that stress is associated with PTSD or PTSD-like symptoms, although the studies are hampered by some methodological limitations. A connection to other psychological disorders is also evident. Both PTSD and other psychological health problems show a modest association with stress, with the relationship more pronounced in those who experience high stress. Little evidence connects stress to self-reported physical symptoms.

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GLOSSARY

BDI	Beck Depression Inventory
BSI	Brief Symptom Inventory
CAGE	Screening Instrument used to assess alcohol disorder
CES	Combat Exposure Scale
DIS	Diagnostic Interview Schedule
DSM-III-R	Diagnostic and Statistical Manual of Mental Disorders (3rd Edition, Revised)
GHQ	General Health Questionnaire
GSI	General Severity Index (of the SCL-90-R)
HSC	Health Symptom Checklist
IES	Impact of Events Scale
MISS	Mississippi Scale for Combat-Related Post-Traumatic Stress Disorder
MISS-ODS	Mississippi modified for ODS
MMPI-2	Minnesota Multiphasic Personality Inventory
ODS	Operation Desert Storm
ODS-SES	Operation Desert Storm Stress Exposure Scale
PCL-MIL	PTSD Symptom Checklist—Military Version
PGW	Persian Gulf War
PRIME-MD	Primary Care Evaluation of Mental Disorders
PTSD	Posttraumatic stress disorder
SCID	Structured Clinical Interview for DSM-III Disorders
SCL-90-R	Hopkins Symptoms Checklist (Revised version)
SF-36	Short Form 36-Item Health Questionnaire
SSQR	Social Support Questionnaire
STAI	State-Trait Anxiety Inventory
STAS	State-Trait Anger Scale
WOC	Ways of Coping Scale

This report summarizes the existing scientific literature on the health effects of stress. Over the past half century, stress has been widely studied. Because literally thousands of articles, books and reviews on stress have been published, this report is intended to be a concise summary rather than a detailed review of the literature. The report also summarizes the nature of stressors encountered during Gulf War service, and evaluates the relatively small body of literature on the relationship between stress exposure and health problems experienced by veterans of the Persian Gulf War. This report starts with the recognition that the origins of health problems are often multifactorial, that stress may contribute to these problems, and that stress typically acts in concert with other etiologic agents in influencing health. The intent is to provide information about psychological stress and its potential impact on health that may help guide future policy decisions regarding ways to minimize deleterious health consequences associated with service in future conflicts.

BACKGROUND

On August 2, 1990, Iraqi military forces invaded Kuwait. In response, the United Nations Security Council passed Resolution 660, condemning the invasion and calling for the immediate withdrawal of Iraqi troops. Four days later, on August 6, Saudi Arabia requested American military intervention, ultimately leading to the largest military deployment since World War II.

Between August 1990 and June 1991, the United States deployed approximately 697,000 military personnel to the Persian Gulf in Operations Desert Shield and Desert Storm (Presidential Advisory Committee, 1996). Over nearly a six-month period, mobilization of U.S. forces to the Persian Gulf proceeded at a pace unprecedented in military history (Ursano and Norwood, 1996). By August 14, 1990, approximately 5000 troops of the 2nd Brigade, 82nd Airborne Division were in the Gulf region (Martin et al., 1996). Less than a month later, approximately 150,000 service personnel were in the Gulf theater. By year-end 1990, a

total force exceeding 372,000 troops had been deployed (Spektor, 1998), with this number rising to approximately 535,000 by March 1991 (Holsenbeck, 1996).

Military personnel of both genders, numerous racial/ethnic groups, and ages from 17 through 65 years were deployed. Of the total troops deployed, 84 percent were active-duty personnel and 16 percent were in a reserve or guard component.

Initial deployment of U.S. forces had been intended primarily as a show of force, with the expectation that Iraq would exit Kuwait once confronted by the presence of U.S. troops and the weight of world opinion (Martin and Fagan, 1997). By late October, however, Secretary Cheney announced that Coalition forces would take offensive action to force Iraq out of Kuwait, thereby ending any expectation of an early end to the campaign (Wright, Marlowe, and Gifford, 1991).

In late November, the U.N. Security Council imposed a deadline of January 15, 1991, for Iraqi withdrawal from Kuwait, sanctioning the use of force against Iraq (Gifford et al., 1996). Upon Iraq's failure to withdraw, Operation Desert Storm was initiated on January 17. Beginning with a series of intensive air attacks, Operation Desert Storm culminated in a massive, but brief, ground offensive by Coalition forces. On February 28, four days after the ground war had begun, a temporary cease-fire went into effect. As Iraqi forces began withdrawal from Kuwait, however, sporadic attacks on U.S. forces continued. On March 2, 1990, in the last major battle of the war, U.S. forces engaged a retreating Iraqi column that had charged across the front of the 1st Brigade, 24th Mechanized Infantry Division (Martin et al., p. xxix, 1996). The result was the destruction of the fleeing Iraqi soldiers and of every Iraqi vehicle, including 185 tanks and armored vehicles, 400 trucks, and 34 artillery pieces. The location of this battle became known as the "Highway of Death." As peace was restored, U.S. forces withdrew from the Persian Gulf even more rapidly than they had been initially deployed. By June 13, only two months after formal end to hostilities, the last U.S. service members who had participated in the ground war itself had left the region, replaced by peacekeeping forces. (A timeline depicting key events of Operations Desert Shield and Desert Storm is shown in Figure 1.1.)

RETURNING U.S. TROOPS REPORT HEALTH PROBLEMS

Given the large scale of the deployment, the war against Iraq was successfully prosecuted with comparatively little injury or loss of life to U.S. forces. Nonetheless, in the months and years following the end of the war, U.S. military personnel reported health symptoms or problems, many of which were attributed by veterans to their deployment to the Persian Gulf. In response to these concerns, the federal government established clinical evaluation pro-

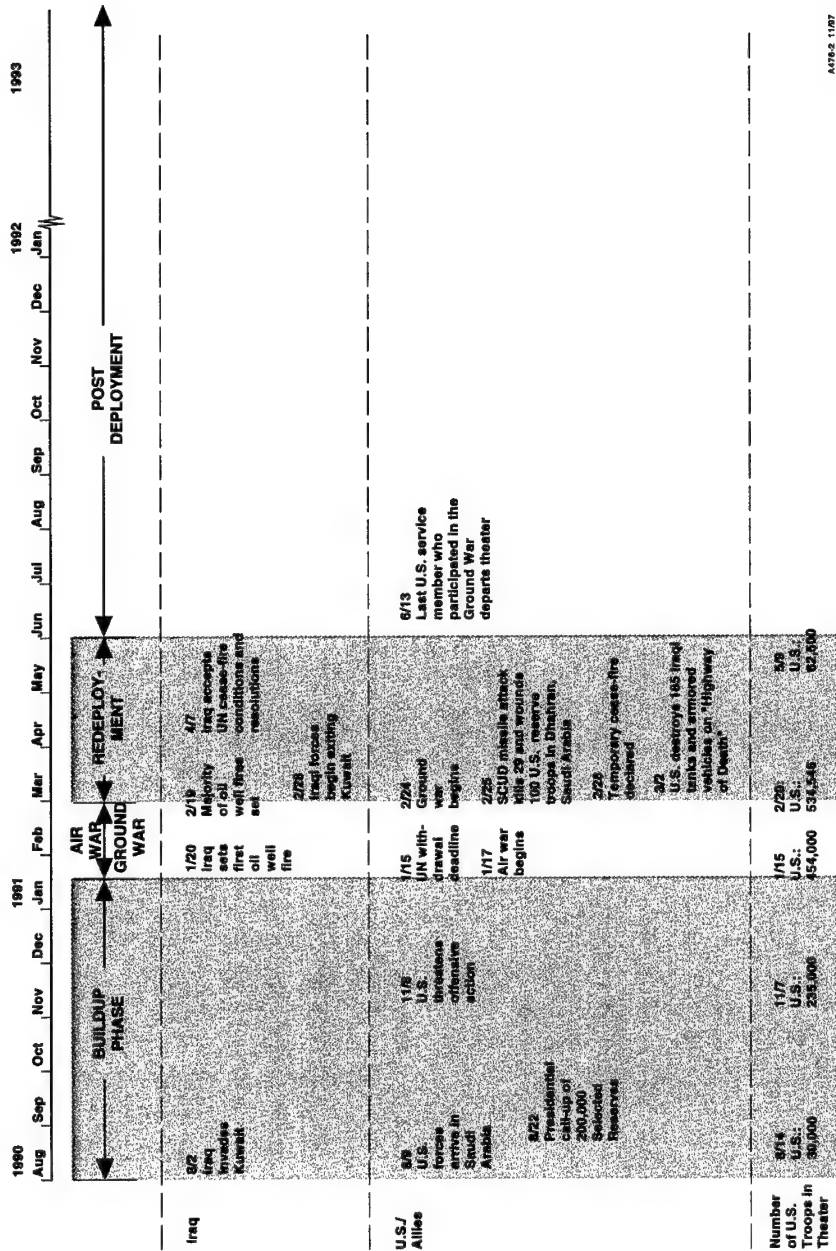


Figure 1.1—Operation Desert Storm/Operation Desert Shield Timeline

grams through the auspices of the Department of Defense (DoD) and the Department of Veterans Affairs (VA). Over 100,000 individuals have now been evaluated in these clinical evaluation programs established to diagnose and provide treatment for the ailments experienced by veterans of the Gulf War who request a medical evaluation.¹ These programs—the Comprehensive Clinical Evaluation Program (CCEP) and the VA Persian Gulf Health Registry (VA Registry)—provide the best available clinical description of these health problems.

Table 1.1 shows the wide array of symptoms that have been reported by Gulf War veterans in both clinical programs. They range from potentially minor, frequently self-limiting conditions (e.g., headache) to more serious conditions. The most common symptoms can be associated with multiple conditions (e.g., sleep problems are symptomatic of sleep apnea, fibromyalgia, depression, and other medical conditions), and frequently lack a clear-cut organic explanation. They may be attributed to either physiological or psychological conditions, or to a combination of both. Psychiatric and physical illnesses are not mutually exclusive and frequently coexist (Engel and Katon, 1996).

Table 1.2 shows the most common diagnoses assigned to veterans in the CCEP and VA Registry. The most common categories are musculoskeletal diseases;

Table 1.1
Ten Most Common Symptoms Reported by Program Participants
(Percent)

Reported Symptom	CCEP (N=18,075)		VA Registry (N=52,216)
	Chief (percent)	Any of top seven (percent)	Any of top three (percent)
Asymptomatic	10	10	12
Joint pain	11	49	17
Fatigue	10	47	20
Headache	7	39	18
Memory loss	4	34	14
Sleep disturbance	2	32	6
Rash/dermatitis	7	31	18
Difficulty concentrating	<1	27	NA
Depression	1	23	NA
Muscle pain	1	21	a

SOURCE: PAC, 1996.

NOTE: NA = Not available; values rounded to the nearest percent.

^aIn the VA registry, muscle and joint pain combined are 17 percent.

¹At the time of this report, actual data were available on roughly 70,000 veterans.

Table 1.2
Frequency Distribution of Major Diagnostic Classifications
(Percent)

Diagnostic Category	CCEP (N = 18,075)	VA Registry (N = 52,216)
Ill-defined conditions	18	23
Musculoskeletal disease	18	25
Psychiatric disorders	18	15
Respiratory system	7	14
Skin/Subcutaneous tissue	6	14
Nervous system	6	8
Digestive system	6	12
Circulatory system	2	7
Infectious disease	3	6
Injury and poisoning	1	1
Neoplasm	1	1

SOURCE: PAC, 1996; Murphy et al., 1997.

NOTE: Persons categorized as "healthy" have been omitted.
 Values rounded to the nearest percent.

symptoms, signs, and ill-defined medical conditions (SSID); and psychological disorders. Diagnoses within the musculoskeletal area include rheumatoid arthritis, degenerative disorders, fibromyalgia, tendonitis, pain in joint, bursitis and lower back pain. Many of these are wear and tear disorders that could be expected in physically active military populations. Diagnoses within psychological conditions include somatoform problems (e.g., tension headache), mild or stress-related anxiety, depression, and posttraumatic stress disorder. The symptoms, signs, and ill-defined conditions (classified according to International Classification of Diseases, ICD-9, Codes) include "symptoms, signs, abnormal results of laboratory or other investigative procedures and ill-defined conditions regarding which no diagnosis classifiable elsewhere is recorded."² The most frequent symptoms in this category (e.g., fatigue, headaches, sleep disturbance, memory impairment, and digestive complaints) are virtually identical to those reported by the group of veterans as a whole in Table 1.1 (Joseph, 1997).

Both the CCEP and VA Registry samples include only those persons who voluntarily sought a medical evaluation from these two clinical programs. Thus, these veterans may not be representative of the total population of troops deployed to the Persian Gulf region. In fact, according to the most recent DoD

²The term "ill-defined" is used in the ICD-9 classification system and refers to symptoms for which a clear diagnosis could not be established. Some of these symptoms are consistent with those considered to be functional or somatoform symptoms.

report on the CCEP (DoD, 1996), the following subgroups have been evaluated by the CCEP at a higher rate than their representation in the military population: female soldiers, African-Americans, those over 30 years of age and Army personnel. In addition, use of these data to measure the extent of health problems is limited by lack of information on the severity and chronicity of symptoms or illnesses reported (i.e., symptoms were measured at a point-in-time and information may not be available on how long symptoms persisted). Thus, the extent and magnitude of health problems experienced by veterans of the Gulf War can not be determined from CCEP and VA Registry data.

Several epidemiologic studies do suggest, however, that symptoms and self-reported chronic conditions occur at a higher rate in deployed personnel than in those who were not deployed. To estimate the scope of the likely impact of deployment, we briefly review below a few key epidemiologic studies (see the companion report by Sloss et al., 1998, for a more detailed review).

One study of Air National Guard personnel from four units found that the prevalence of each of 13 chronic symptoms of at least six months duration was much higher four years after Operation Desert Storm (ODS) in those deployed to the Gulf compared to those not deployed (Kizer et al., 1995; also see Centers for Disease Control, 1995; Fukuda et al., 1998). The excess was most pronounced for diarrhea (4–12 times higher in the deployed) and lowest for headache (1.3–1.6 times higher). Similarly, in a large epidemiologic study of Gulf War veterans and their non-Gulf War counterparts who listed Iowa as their home state, health problems were reported at a higher rate by deployed personnel (The Iowa Persian Gulf Study Group, 1997). Deployed regular military personnel reported greater levels of depression (16 percent versus 11 percent), post-traumatic stress disorder (1.9 percent versus 0.7 percent), chronic fatigue (1.0 percent versus 0.2 percent), cognitive dysfunction (17.7 percent versus 7.4 percent), bronchitis (3.2 percent versus 2.8 percent), asthma (6.7 percent versus 3.8 percent), fibromyalgia (18.2 percent versus 9.2 percent), alcohol abuse (17 percent versus 12.2 percent), anxiety (3.9 percent versus 1.9 percent) and sexual discomfort (1.2 percent versus 1.1 percent). Similar differences were found between deployed and nondeployed National Guard/Reserve personnel.

Bodily symptoms were also found to be related to deployment status in studies of active duty and Reserve personnel from the states of Pennsylvania and Hawaii two years post-ODS (Walter Reed Army Institute of Research, 1994; Stretch et al., 1995). For example, active duty deployed troops compared to nondeployed troops reported significantly higher symptom levels (in 20 out of 23 symptoms measured) including: headaches (45 percent versus 24 percent), back problems (29 percent versus 15 percent), allergies (13 percent versus 9 percent) stomach upset (22 percent versus 8 percent) muscle aches (27 percent versus 13 percent), and aching joints (31 percent versus 16 percent).

In contrast, studies of more serious health problems (and those that can be measured more objectively) have found similar rates of disease-specific mortality in Gulf War veterans and their nondeployed military counterparts (Kang and Bullman, 1996) and similar rates of birth defects in offspring born in military hospitals to deployed and nondeployed veterans (Cowan et al., 1997). Finally, Gulf War veterans had similar rates of postdeployment hospitalization for most conditions, although Gulf War veterans did have an increased risk of hospitalizations for neoplasms (mostly benign), diseases of the genitourinary system, diseases of the blood, and mental disorders, including adjustment reactions, and drug and alcohol dependence (Gray et al., 1996).

Although the magnitude of health problems is as yet unknown, the symptoms found among Gulf War veterans do not appear unique to the Gulf War experience. Numerous studies of primary care populations indicate high rates of bodily symptoms similar to those reported by CCEP and the VA Registry participants (Koch, 1975; Kroenke, 1989). Fatigue, dizziness, insomnia, and various pain syndromes are among the leading complaints in primary care (Koch, 1975).³ The frequency of somatic symptoms as a presenting problem in primary care clinics across a wide variety of cultures was demonstrated in a recent study by the World Health Organization, which showed an overall rate of about 20 percent in 15 centers around the world (Gureje et al., 1997). Even in community samples, somatic symptoms are common, with lifetime prevalence rates of 37 percent for joint pain, 31 percent for back pain, 25 percent for headache and 24 percent for fatigue (Kroenke and Price 1993). These studies are not fully comparable to the CCEP program, however, since Gulf War veterans tend to be younger and more likely to be male than are patient and community samples.

It should also be noted that symptoms and illnesses seemingly similar to those found among Gulf War veterans have been reported by soldiers of other wars (e.g., Hyams, Wignall, and Roswell, 1996). For example, during the Civil War, DaCosta evaluated 300 soldiers, identifying a syndrome called irritable heart that was characterized by diarrhea, dizziness, shortness of breath, sleep disturbance, headache, palpitations and chest pain (DaCosta, 1871). Similar constellations of symptoms were classified as soldier's heart or effort syndrome in World War I, battle fatigue in World War II, and were possibly attributed to Agent Orange exposure in the Vietnam War (Hyams et al., 1996). A companion

³In a study of primary care active-duty military personnel and their dependents, as well as retired service members, 38 percent of the sample reported one or more symptoms (e.g., chest pain, fatigue, dizziness, headache, edema, back pain, dyspnea, insomnia, abdominal pain, numbness, impotence, weight loss, cough, constipation) during a three-year period (Kroenke and Mangelsdorff, 1989).

report in this series describes the kinds of symptoms and responses experienced by soldiers in prior wars (Marlowe, forthcoming).

PURPOSE OF THIS REPORT

To this point, no single cause of the problems experienced by veterans has been identified. Moreover, multiple etiological agents have been postulated to have contributed to the health problems experienced by Gulf War veterans. Some of these possible causal agents include exposure to chemical and biological weapons, depleted uranium, smoke from oil well fires, pesticides and insect repellents, reactions to prophylactic drugs (e.g., pyridostigmine bromide) or vaccines, infectious diseases, and psychological stress. The focus of the current report is to summarize the scientific literature on the known effects of one possible causal agent, i.e., stress, on health. The report also summarizes what is known concerning exposure to stressful experiences in the Persian Gulf and evaluates the literature on the relationship between stress exposure and health problems experienced by veterans of the Persian Gulf War.

This report does not address, in detail, the historical literature on the role of stressful wartime experiences on morbidity. A detailed discussion of this topic is provided in a companion report by Marlowe (forthcoming). That report describes the health consequences of participation in war and posits that observed differences are due, at least in part, to historical variation in cultural beliefs, differences in medical knowledge, and attributions about causation. In addition, Marlowe posits that predispositions and vulnerabilities, as well as cultural differences, help shape illness responses (i.e., subjective experiences of physical or emotional symptoms) in the context of deployment and combat. As suggested by Marlowe (forthcoming), it is likely that symptoms reported by Gulf War veterans are multifactorial in nature and not due to a single cause.

SOURCES OF EVIDENCE DRAWN UPON TO ACCOMPLISH OUR OBJECTIVE

To accomplish our objective, we examined three sources of evidence: (1) the general, i.e., non-Gulf War-related, scientific literature concerning the link between stress and health; (2) the available data concerning the stresses faced by personnel deployed to the Persian Gulf; and (3) the body of empirical studies bearing directly on the link between stress and health problems experienced by Gulf War veterans. Relevant literature was identified by an extensive review of the research data base, including computerized literature searches of *Psychological Abstracts*, *MedLine*, and *Defense Technical Information Center* (DTIC), as well as the PILOTS data base compiled by the National Center for Posttraumatic Stress Disorder.

With regard to the general literature on stress, health, and related topics, we identified several thousand articles spanning several decades. To narrow our focus, we emphasized research published within the past 15 years that appeared in peer-reviewed scientific journals. In all, we consulted more than 250 articles, books, and technical reports, including both theoretical and empirical analyses. The review spanned a range of topics, including the nature of stress and the stress process, the role of stress and other risk factors in contributing to poor health, the pathways by which stress is linked to poor health, and the types of illnesses and diseases associated with stress. With respect to the literature concerning stressors faced by personnel deployed to the Persian Gulf, we identified approximately 55 pertinent research articles, book chapters, and technical reports. As noted in the chapter detailing this information, we focused on key surveys of Gulf War personnel administered both during deployment and after the war's end.

As for studies pertaining directly to the putative link between stress and health problems experienced by Gulf War veterans, we consulted approximately 60 articles and technical reports that presented original data as well as review articles and editorials.

ORGANIZATION OF THE REPORT

This report contains six chapters, including this introduction. Chapter Two presents brief definitions of stress, illness, and disease, discusses theoretical models linking stress to poor health, and concludes by outlining a conceptual framework for understanding war zone stress to provide a context for the later chapters. After a brief discussion of personnel judged to be at heightened risk for stress-related reactions, Chapter Three reviews survey data pertinent to determining the nature of the potentially stressful circumstances encountered by deployed personnel, the degree to which these experiences were perceived to be stressful by Gulf War participants, and the pervasiveness of stress exposure throughout the theater. Chapter Four selectively reviews the vast general (i.e., non-Gulf War-related) empirical literature implicating stress as one of many factors that may contribute to health problems. Chapter Five evaluates the relatively small body of literature directly bearing on the relationship between stress exposure and health problems experienced by veterans of the Persian Gulf War. Finally, in Chapter Six, we provide an integrative summary of our findings and highlight key conclusions.

STRESS AND HEALTH: DEFINITIONS AND CONCEPTS

This chapter presents definitions of illness, disease, and stress, as well as a conceptual model of the processes by which stress may be linked to poor health. It also lays out a conceptual framework for understanding war-zone stresses and their impact on military personnel.

ILLNESS AND DISEASE

Illness and disease are overlapping, but distinct, constructs. Whereas disease refers to constellations of symptoms that define a diagnosable physical or psychiatric disorder, illness refers to the subjective experience of poor health. Illness manifests itself as somatic (bodily) or psychological symptoms, but may stem from multiple sources—including cognitive and social processes—and may or may not reflect the presence of an underlying disease (Kleinman, 1988). The relationship of illness to disease is complex. A person may experience ill health with no underlying disease. Conversely, he or she may suffer from an underlying disease without perceiving himself or herself as ill (Weiner, 1992).

STRESS

Human beings survive by constantly adapting to the demands of an ever-changing environment. For the purposes of this review, we define stress as a real or perceived imbalance between environmental demands required for survival and an individual's capacity to adapt to these requirements (Lazarus and Folkman, 1984; Chrousos and Gold, 1992; Lovallo, 1997; Pearlin, Lieberman, Menaghan, and Mullen, 1981; Weiner, 1992). This general model regards stress as part of a sequential process in which objective environmental circumstances (i.e., stressors) are appraised by the individual as either having no adaptive significance or as stressful (i.e., presenting a potential threat, danger, change or challenge to one's well-being or survival). If circumstances are perceived by the individual as stressful, then this appraisal will set in motion

a series of stress-response mechanisms comprised of integrated physiological, behavioral, and psychological efforts to adapt to the environmental demands.

CONCEPTUAL MODELS LINKING STRESS TO POOR HEALTH

Although differing in minor respects, current conceptual models hypothesize several pathways by which stress might influence illness or disease (Cohen, Kessler, and Gordon, 1995; Cohen and Rodriguez, 1995; Krantz, Grunberg, and Baum, 1985; McEwen and Stellar, 1993; Steptoe, 1991). As shown in Figure 2.1, the literature generally characterizes the stress process as beginning when an individual appraises environmental demands as exceeding his or her adaptive resources. Within such models, stress is viewed as an inherently psychological process. For this reason, our review emphasizes the psychology of stress. We recognize, however, that physical stress (e.g., prolonged exposure to extreme temperatures) may influence health independently of psychological mechanisms.¹ The perception of stress is a complex process, involving both the individual and the environment. On the one hand, certain objective circumstances are consensually judged as more stressful than others (e.g., Miller and Rahe, 1997). Some of the characteristics that influence the stressfulness of an event include its intensity, chronicity, and complexity (Paterson and Neufeld, 1987) as well as its novelty, ambiguity, unpredictability, and uncontrollability (Averill, 1973; Mineka and Henderson, 1985; Thompson, 1981). At the same time, whether or not individuals perceive a given set of circumstances as stressful depends upon their own life experiences as well as their personal, social, and biological resources and vulnerabilities.

Thus, stress appraisals take into consideration an individual's repertoire of existing coping resources and individual vulnerabilities (Lazarus and Folkman, 1984; Kessler, Price, and Wortman, 1985; McEwen and Stellar, 1993; Steptoe, 1991), with these factors occupying a central role in most models of stress and health. Such models view stress as acting in concert with other factors to foster health problems, rarely regarding stress as a sufficient cause in itself. In fact, predisposing biological and psychosocial resources and vulnerability factors play a dual role in processes linking stress and health. First, individuals with more resources and fewer vulnerabilities may be less likely to perceive a given set of circumstances as stress-provoking. Second, when events are perceived as stressful, these individuals seem better able to adjust to the demands of the

¹Laypeople commonly hold the misperception that mental and physical processes are unrelated to one another as manifested by the colloquial expression that stress is "all in the head." The roots of this fallacy can be traced to the mind-body distinction drawn by the early philosopher, Descartes, and run counter to current scientific knowledge (for discussion, see Damasio, 1994).

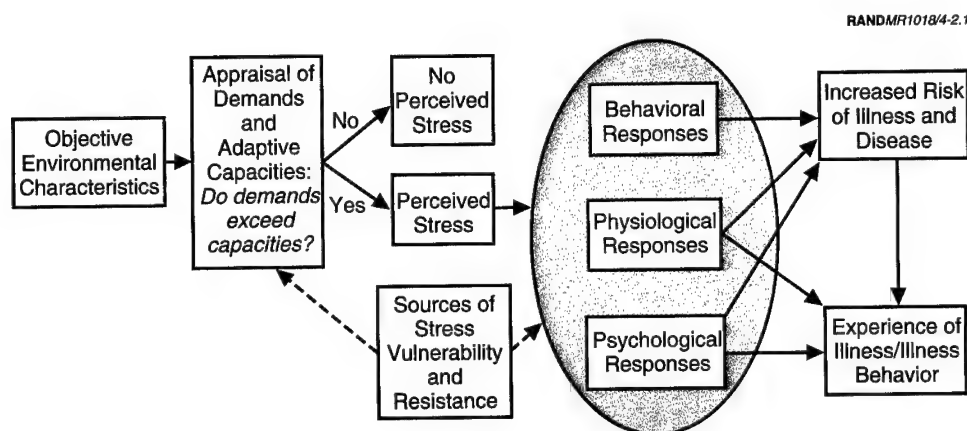


Figure 2.1—Conceptual Model Linking Stress Exposure to Poor Health

stress-provoking situation.² As shown in Figure 2.1, when sufficiently intense, perceived stress may activate physiological, behavioral, and psychological processes that place individuals at heightened risk for health problems or illness behavior (Cohen et al., 1995; Cohen and Rodriquez, 1995; Krantz et al., 1985; McEwen and Stellar, 1993; Steptoe, 1991).³

Most models suggest that physiological, behavioral, and psychological processes may directly influence health in specific ways. Physiological mechanisms implicated in illness and disease include the autonomic nervous system and neuroendocrine mediators that influence immune, gastrointestinal, neuromuscular, and cardiovascular systems among others (de la Torre, 1994; McEwen, 1998; McEwen and Stellar, 1993). Acute activation of these systems is known to precipitate short-term adaptive physiological changes as well as a whole range of somatic symptoms (e.g., rapid heart rate, increased perspiration, gastrointestinal motility) that may be experienced as symptomatic of ill health (Chrousos and Gold, 1992). Although physiological activation has short-term adaptive benefits, chronic activation of these systems is believed to enhance vulnerability to cardiovascular, metabolic, immune-related, and other diseases (Chrousos and Gold, 1992; McEwen, 1998; McEwen and Stellar, 1993) as well as changes in the central nervous system and the structure of the brain itself (Sapolsky, 1996). Recent evidence in both animals and humans also suggests

²Given the centrality of these factors that may heighten susceptibility or confer resistance to stress, they will be addressed in more detail in Chapters Four and Five.

³Most models regard illness and illness behavior as overlapping, but distinct, phenomena. Individuals may experience or perceive themselves as ill, thus stimulating illness behavior (e.g., medical help-seeking or staying in bed all day), even in the absence of any underlying syndrome (e.g., Mechanic, 1972; Pennebaker, 1982). Conversely, persons who are in poor health may not display illness behavior.

that exposure to stressful events may increase the permeability of the blood brain barrier, thus rendering the central nervous system susceptible to drugs that typically act only on peripheral mechanisms (Friedman, Kaufer, Shemer, Hendler, Soreq, and Tur-Kaspa, 1996).

Behavioral responses to stress can also heighten risk of illness and disease. Individuals under stress are more likely to engage in behaviors with significant ramifications for health, including altered eating and sleeping habits and heavier consumption of alcohol and other substances (e.g., Brown, 1989; Conway, Vickers, Ward, and Rahe, 1981; McCann, Warnick, and Knopp, 1990).

Psychological mechanisms have been implicated as influencing health in at least two ways. First, patterns of thinking about oneself and one's world may place individuals at heightened risk for various forms of psychopathology, including depression (e.g., Beck, Rush, Shaw, and Emery, 1979) and anxiety (e.g., Schwarzer and Wicklund, 1991). Second, under stress, cognitive or social factors may heighten an individual's perception of himself or herself as sick, either by increasing awareness of bodily sensations that might otherwise go unrecognized (Pennebaker, 1982) or by prompting individuals to attribute normal symptoms or bodily sensations to evidence of pathology requiring medical intervention (Mechanic, 1972).

A CONCEPTUAL FRAMEWORK FOR UNDERSTANDING WAR ZONE STRESSORS

Classic discussions of war-related stress have long recognized that the war zone is replete with hardships and dangers, including many that are only secondarily related to combat itself (e.g., Grinker and Spiegel, 1945; also see Hobfoll, Spielberger et al., 1991). Much research attests to the impact of exposure to combat on subsequent mental health outcomes (e.g., Carroll, Rueger, Foy, and Donahoe, 1985; Foy et al., 1984; Foy, Resnick, Sippelle, and Carroll, 1987; Kulka, Schlenger, Fairbank et al., 1990; O'Toole, Marshall et al., 1996a). In general, this literature has documented a dose-response relationship between exposure to actual combat and increased risk of mental health problems. Although the literature concerning stress-related somatic health consequences is far less developed than its mental health counterpart, a small body of research suggests that veterans of combat subsequently report poorer perceived health, more somatic symptoms, more chronic health problems, and greater use of health services (e.g., O'Toole, Marshall et al., 1996b). This research will be discussed in greater detail in a subsequent section.

More recent research, using a taxonomy that distinguishes between high- and low-magnitude stressors, has systematically studied the possibility that war-zone deployment may be associated with a wide range of potential stressors

(i.e., King, King, Gudanowski, and Vreven, 1995; Litz, King et al., 1997; Litz, Orsillo et al., 1997). These additional stressors include not only direct exposure to combat and other high-magnitude events such as exposure to atrocities (e.g., horrific carnage or body mutilation), but also to low-magnitude events such as separation from loved ones (Litz, Orsillo et al., 1997) and exposure to harsh living conditions such as lack of privacy, limited opportunity for recreation, long work hours, and difficult climatic conditions (King et al., 1995; Litz, King et al., 1997). Low-magnitude war zone stressors are not confined to separation from loved ones and harsh living conditions, however, and may include any other events or circumstances that foster a sense of personal disheartenment, discomfort, or demoralization (Litz, King et al., 1997).

The impact of war-zone exposure to low-intensity events has only recently been subjected to systematic empirical research (e.g., King et al., 1995; Litz, King et al., 1997), and much remains to be learned about the nature and circumstances in which these exposures lead to stress-related health consequences. Nonetheless, available data indicate that these seemingly ordinary experiences may be more potent stressors than previously believed. In particular, exposure to low-level daily hassles appears to predict adjustment outcomes independently of exposure to high-magnitude stressors. Consistent with general knowledge about stress exposure, recent empirical efforts to examine war-zone stress also underscore the importance of perceived, as well as actual, stressful circumstances (Solomon, Mikulincer, and Hobfoll, 1987; King, King et al., 1995). For example, analysis of data from the National Vietnam Veterans Readjustment Study (Kulka et al., 1990) revealed that self-appraised exposure to danger was a significant predictor of subsequent stress reactions (King, King et al., 1995).

In summary, a comprehensive representation of war zone stressors would consist of at least three components, any one of which may be sufficient to precipitate adverse stress reactions: (1) exposure to low-intensity events such as—but not limited to—harsh living conditions as well as separation from loved ones and its attendant hardships; (2) exposure to high-magnitude events such as involvement in actual combat or its often grotesque aftermath; and (3) exposure to conditions in which individuals perceive either themselves or others to be at risk of serious injury or loss of life.

STRESS EXPOSURE IN THE PERSIAN GULF WAR

This chapter reviews available data concerning the degree to which deployment to the Persian Gulf theater was experienced as a stressful event by military personnel. After a brief overview of potential stresses faced by deployed personnel both during and after deployment, the chapter describes groups postulated to be at particularly high risk of negative reactions to stress exposure. Finally, the chapter evaluates key surveys of deployed personnel to determine the types of experiences found to be stressful and the levels of perceived stress precipitated by those circumstances.

OVERVIEW OF STRESSES EXPERIENCED BY VETERANS OF THE GULF WAR

Although comparatively few personnel participated in actual combat—an experience lay people regard as the essence of war-zone stress—deployment was associated with myriad circumstances potentially capable of fostering psychological stress. First, the unexpected and rapid nature of the deployment itself created personal and family hardships, especially for Reservists (Peebles-Kleiger and Kleiger, 1994). Moreover, service in the Persian Gulf, particularly in the build-up phase of the deployment, was associated with multiple stressors including crowded or austere living conditions, long work days, a harsh climate characterized by wide extremes in temperature, pervasive sand, confinement to base camps with little opportunity for customary recreational outlets, separation from loved ones, and nearly total isolation from indigenous populations (Ford et al., 1992; Gifford, Martin, and Marlow, 1991; Gifford et al., 1996; Wright, Marlowe et al., 1995; Wright, Marlowe, and Gifford, 1991). In the early stages of the deployment, the challenge of facing these hardships was amplified due to uncertainty about the length and nature of the mission.

Apprehensions about Iraqi military capabilities—including the possibility of terrorist attack and infiltration by Iraqi special forces—fueled by news coverage, heightened fears concerning the danger of an eventual military engagement.

Casualty forecasts were reported by the media to be as high as 20,000-50,000, with projections frequently interpreted by soldiers to refer to combat mortality rates rather than total combat-related morbidity (Wright, Marlowe, and Gifford, 1991). Casualty estimates for some units were projected to be as high as 50-80 percent for the ground war (Ford et al., 1992).

Iraq was known to have used chemical weapons against Iran and in suppressing its own people, prompting widespread concern about the potential use of deadly chemical or biological warfare agents and the ever-present need for vigilance against such attacks. Apprehension and uncertainty about possible attacks, the effectiveness of defensive suits, and the possible side effects of prophylactic agents aimed at mitigating consequences of exposure to chemical weapons served as a constant backdrop to the day-to-day hardships of preparation for possible war. Constant training for a chemical and biological attack and numerous alarms indicating possible chemical detections increased the salience of this potential threat. In addition, the threat of random SCUD missile attacks—borne out by the destruction of a reserve unit barracks facility and the resulting death of 29 persons (Perconte et al., 1993b)—was theater-wide.

As noted earlier, some experienced traditional combat activities, although relatively few. Moreover, in the aftermath of the highly successful air and ground offensives, many personnel—including noncombatants—were exposed to evidence of widespread devastation, including the deaths of tens of thousands of Iraqis, causing some personnel to experience guilt. "It was difficult not to feel like a bully after having seen the rag-tag bunches of ill-clothed young men who constituted the fifth largest fighting force in the world" (Holsenbeck, 1996).

Finally, veterans—many of whom had little time between leaving the theater and returning to community life (Rodell, Cooley et al., 1992)—reentered a society soon to be confronted by widespread and unrelenting concerns about the possible negative health effects of Gulf War service. Even before the war had ended, efforts were underway to examine potential health problems associated with Gulf War service (e.g., U.S. Army Environmental Hygiene Agency, 1994). Moreover, in 1992, not long after the end of hostilities, two separate incidents of possible outbreaks of symptoms involving units deployed to the Persian Gulf received widespread media attention (Berg, 1994; DeFraités et al., 1992). Although no definitive conclusions have yet been drawn concerning the origins of these symptoms, these reports served to further sensitize veterans to possible health issues associated with Gulf War service. Ambiguity concerning the origins of health problems reported by some Gulf War veterans continues to this day, with media accounts (e.g., see Fumento, 1995) and conflicting reports (Presidential Advisory Committee, 1996; General Accounting Office, 1997; House Committee, 1997) contributing to an ongoing, stress-provoking climate

of distrust, recrimination, and suspicion of government cover-ups and obstruction (cf. Presidential Advisory Committee, 1997).

CERTAIN INDIVIDUALS WERE POSTULATED TO BE AT HIGH RISK FOR STRESS REACTIONS

The impact of the stressors associated with the Gulf War were hypothesized to vary by different subpopulations of veterans. The following characteristics were expected to be associated with greater-than-average risk for stress-related problems. As discussed below, these risk factors were not mutually exclusive, and in some instances cut across multiple groups.

Combat Support and Combat Service Support Units

Combat support and combat service support (CS/CSS) units (e.g., medical units, grave registration, chaplains, combat engineers, chemical weapons, maintenance and transportation units) and brigade-size or larger units without their own mental health service providers (e.g., the 3rd Armored Cavalry Regiment) were hypothesized to be at risk for developing high levels of combat stress (Ruck, 1996; Wright et al., 1991). In general, CS/CSS units—many of which were reserve units—were considered to be at risk due to the long duty hours they worked to build a mature theater base, the lack of integration of some personnel and units into their assigned parent organization, and the ill-preparedness of some units for combat or war-zone deployment (Ford et al., 1992). Once the war was over, many of these units continued to work long hours in-theater, moving personnel and equipment out of the theater, helping with reconstruction, and treating large numbers of Iraqi POWs (Garland, 1993).

Reservists and Reserve Units

Reservists were hypothesized to be particularly vulnerable to the various stressors associated with the different phases of the deployment for several reasons:

- The abrupt call-up and rapid mobilization of Reserve and National Guard personnel left soldiers, as well as their spouses and families, with little time to adjust to departure. Many were unprepared for the possibility of an extended deployment, with most assuming that 180 days would be their maximum length of deployment (Ford et al., 1992).
- The predeployment strengths of many reserve units were often much lower than anticipated, resulting in widespread cross-leveling. Due to problems with readiness, reserve units were frequently broken apart, with individuals or small teams of reservists used to augment other active-duty and reserve

units. In general, the use of reservists in this manner increased the likelihood of social integration problems in-theater.

- Uncertainty existed as to where reservists might be sent. In one instance, for example, reservists were required to participate in a lottery to determine whether they would be deployed to Saudi Arabia or to backfill European bases or bases within the continental United States (Ford et al., 1992).
- Many reservists worried that their civilian businesses or practices would suffer or that their civilian jobs would not be awaiting them due to their lengthy absence. Members of reserve CS/CSS units who were kept in-theater after the war to help with the reconstruction phase resented seeing combat units being redeployed first (Garland, 1993).
- Some reservists returned home to face the loss of job security or financial hardships resulting from the loss of income during the deployment (Ford et al., 1992).
- Upon return to civilian life, many reservists lacked the social support systems available to active-duty troops returning to their home bases (Ford et al., 1992).

Persons or Units Not Assigned to a Parent Unit

Individuals or units not assigned to a parent unit or who were new to a unit also were considered to be at risk due to a lack of well-established support systems in-theater. For example, numerous Army units deployed to the Gulf had as many as 25 percent of their soldiers who were new to the unit at the time of deployment (Armfield, 1994). Units with low cohesion or poor leadership during the Gulf War also were hypothesized to be particularly at risk (Gifford et al., 1996).

Persons Who Experienced High-Magnitude Stressors

Persons exposed to high-magnitude stressors, resulting from either direct or vicarious exposure to combat or its aftermath, also were considered to be at risk for developing stress reactions (Belenky et al., 1996; Wolfe et al., 1992). Some of these included:

- combat and transport units who had witnessed the combat or its aftermath on the Highway of Death or other areas in which there had been massive human and physical destruction
- survivors of the SCUD missile attack on the reserve unit (Perconte et al., 1993)

- troops exposed to Iraqi dead, including badly burned and mutilated bodies
- persons who observed injured civilians, including Iraqis and Kurds
- personnel whose duties brought them in direct contact with Coalition, enemy, or civilian dead
- soldiers who had participated in direct combat or friendly fire incidents.

Others At Risk

Other persons were also believed to be at high risk. Young personnel, particularly those who were recently married or in troubled relationships, were considered to be at heightened risk for adverse reactions (Wright, Marlowe, and Gifford, 1991). In addition, female soldiers were postulated to be at higher risk, particularly those who were not well integrated into their unit, those with small children, or those who had experienced sexual or other types of harassment in-theater (Ford et al., 1992; Wolfe, Mori, and Krygeris, 1994).

STRESS EXPOSURE AND PERCEIVED STRESS

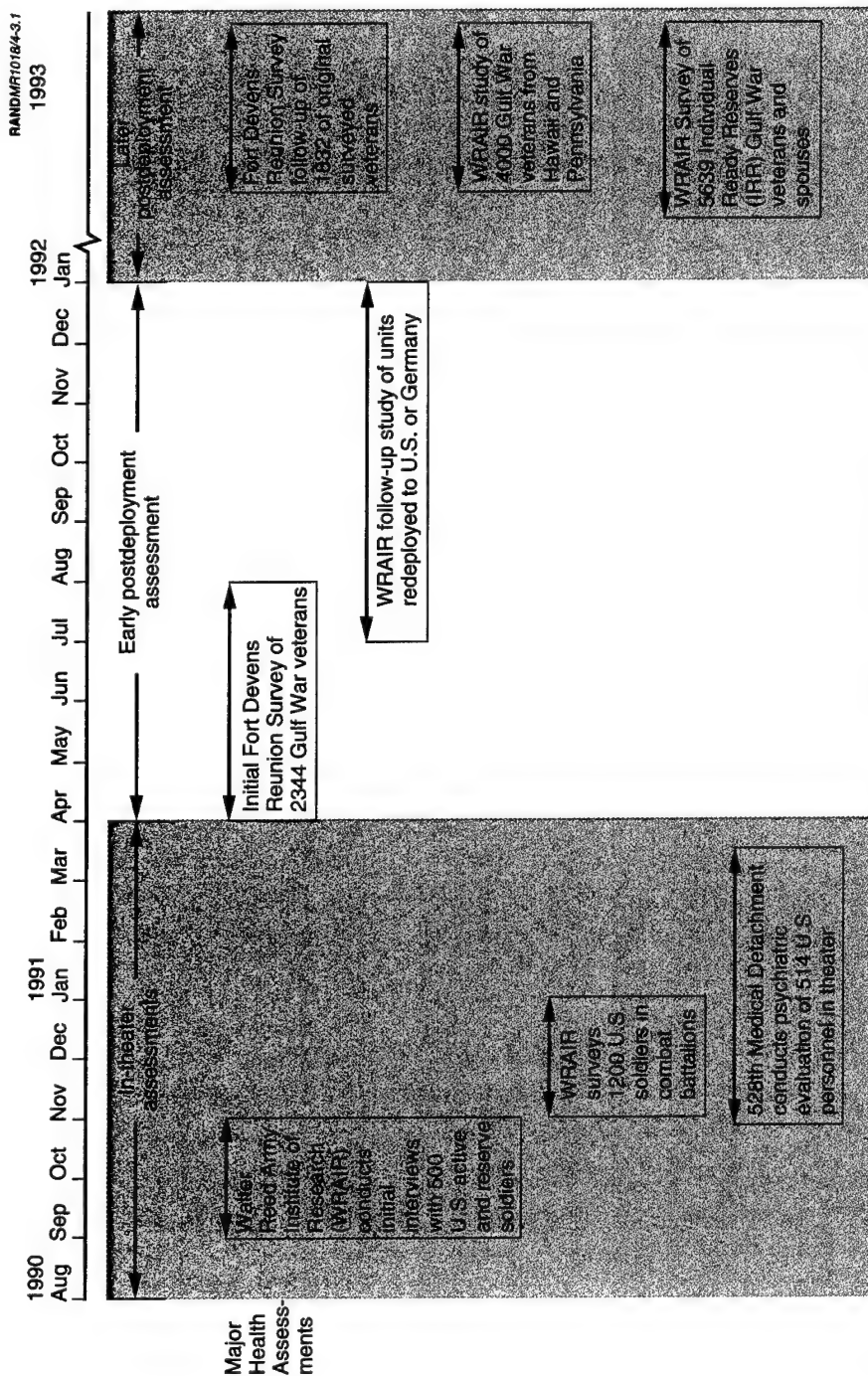
This section reviews available evidence pertaining to stressful life circumstances experienced by veterans of the Gulf War. Data are derived from four different sources: (1) psychiatric evaluations conducted in-theater by mental health teams deployed to the Persian Gulf; (2) in-theater surveys and interview data; (3) postdeployment surveys conducted within days of veterans' departure from the theater; and (4) postdeployment assessments conducted two to three years following the end of the Gulf War.¹ Figure 3.1 shows a timeline of the major health assessments of Gulf War veterans that included measures of stress exposure. Several prospective studies enable a comparison of self-reported stress exposure and perceived stress over time (Martin et al., 1992; Wolfe et al., 1993, 1996).

We identified approximately 20 studies that attempted to measure Gulf War veterans' exposure to stress based either on mental health evaluations or self-reports of Gulf War veterans:²

- in-theater psychiatric evaluations or surveys (Holsenbeck, 1996; Ruck, 1996; Gifford, 1996; Wright et al., 1995; Laedtke, 1996; McDuff and Johnson, 1992; Marlowe et al., 1990; Martin et al., 1992)

¹With the exception of the psychiatric evaluations, data on stress exposure and perceived stress are derived from veterans' self-reports.

²Several studies included assessments conducted at different time periods and so are noted more than once.



NOTE: With respect to the later postdeployment surveys, the veterans included in the studies were surveyed over a period of time. The Fort Devens Reunion Survey was conducted 18–20 months following the return of these veterans to the U.S. WRAIR's study of 4000 Hawaii and Pennsylvania veterans was conducted 2–3 years following their service in the Gulf. WRAIR's study of 5639 individual ready reservists was conducted between May and August 1993.

Figure 3.1—Gulf War Health Assessments Timeline

- early postdeployment surveys (Wolfe et al., 1993; Hammelman, 1995; Southwick and Morgan, 1992; Ford et al., 1992; Sutker et al., 1993; Peebles-Kleiger and Kleiger, 1994; Walter Reed Army Institute of Research (WRAIR), 1994; Martin et al., 1992)
- later post-deployment surveys (Iowa Persian Gulf Study Group; 1997, Wolfe et al., 1996; WRAIR, 1994; Stretch et al., 1995; Stuart and Halverson, 1996).

Overall, findings related to stress exposure were consistent across the various empirical studies and technical reports. In addition, a number of the studies used either the same instruments or modified versions of an instrument to measure self-reported exposure. Given this similarity, we elected to highlight the findings from several key surveys. These studies were selected because they were large and tended to be more representative of Gulf War veterans than other studies—that is, they included either a mix of both active-duty and reserve personnel, CS/CSS and combat units, enlisted personnel and officers, or a range of military occupational specialties. However, we also indicate in the text instances in which smaller studies either support or do not support the findings from the surveys discussed in detail.

MENTAL HEALTH EVALUATIONS IN-THEATER

The vast majority of soldiers assessed in-theater were seen for preexisting problems that may have been exacerbated by the deployment (Ruck, 1996; Holsenbeck, 1996).³ In-theater assessments almost exclusively pertain to the build-up phase. At the time of the Gulf War, the 528th Medical Detachment was the only corps-level active-duty mental health team that was deployed to Saudi Arabia. Of the soldiers who received psychiatric evaluations in-theater, most presented within one month of arrival in-theater, having been referred to the 528th by their chain of command or having independently sought help (Holsenbeck, 1996).⁴ The most common risk factor for psychiatric evaluation was having been deployed to the Persian Gulf within 90 days of assignment to a new unit (Holsenbeck, 1996). Only a few soldiers were seen specifically for combat-related stress reactions.

The corps-level mental health team of the 18th Airborne Corps similarly noted a relationship between being newly assigned to a unit and the type of problems experienced in-theater (Ruck, 1996). Of the 108 soldiers this team treated be-

³Examples of preexisting problems included marital difficulties, poor work performance, poor anger control, somatization disorders, preexisting depression, and eating disorders.

⁴From late October 28, 1990, to March 10, 1991, the 528th Medical Detachment conducted a total of 514 psychiatric evaluations in-theater.

tween mid-November 1990 and March 1991, nearly 20 percent had been with their unit less than three months before they were deployed. A majority of these soldiers had preexisting problems. In general, they were regarded as having poor coping skills that were exacerbated by the deployment (Ruck, 1996).

Mental health services provided to the U.S. Army 7th Corps by the 531st Psychiatric Detachment between late December 1990 and early February 1991 also covered the period encompassed by the air war. Of a total 158 patients treated, 76 percent were soldiers with stress reactions (McDuff and Johnson, 1992). The most common stressors identified were fatigue, cold, sleep deprivation, poor unit leadership and poor morale, and perceived threats to personal safety, which increased dramatically after the start of the air war.

SURVEYS CONDUCTED IN-THEATER

A key set of studies concerning reported stress exposure in-theater was conducted by the WRAIR as part of its effort to evaluate coping and adaptation of U.S. forces in the Persian Gulf. It conducted two in-theater assessments: (a) open-ended interviews with 500 deployed troops during the early phase of the buildup (between September and October 1990; Wright et al., 1995; Gifford et al., 1996);⁵ and (b) a self-administered survey of almost 1200 soldiers from eight combat battalions during November–December 1990 (Gifford et al., 1996).⁶ The survey presented respondents with a list of approximately 60 potential stressors and asked them to indicate the extent to which they were bothered by each using a scale ranging from 1 (none) to 5 (extreme stress).⁷

Observations from the initial set of interviews suggested that problems seemed related to factors that existed before the deployment. During the first few months in the Gulf, the stresses and intense interpersonal contact associated with deployment often exacerbated problems that existed at the unit's home station. Similarly, soldiers' individual problems that existed before the alert ap-

⁵The units visited by the WRAIR team included maneuver battalions from each of the three divisions established in the Persian Gulf, as well as support and headquarters units. Selection of units was done to ensure that the units interviewed were those that had been in the Persian Gulf the longest, were the most forward deployed, had lived under the most austere conditions, or had missions judged particularly stressful by their higher headquarters. When possible, interviewees represented the different organizational levels within a given unit (Wright et al., 1995).

⁶These data collection efforts obtained information on a range of topics. The focus of this chapter is limited to self-reported exposure and perceived stress. It is not possible to determine the survey response rate because the sampling was opportunistic and there was a need to be flexible in the method of distribution. So, surveys were either given directly to the soldiers by the research team or were distributed and collected by the chain of command (Gifford et al., 1996).

⁷Survey instruments differed for enlisted personnel and officers.

peared to have continued or worsened after deployment (Wright et al., 1995; Gifford, 1996).

Results of the WRAIR survey indicated that a substantial number of personnel reported experiencing significant stress during the build-up phase. Stressors could be broadly divided into two categories: (1) those pertaining to harsh living conditions/family-civilian concerns; and (2) those pertaining to the anticipation of combat. With respect to the first category, the circumstances most commonly reported as provoking high levels of stress included uncertainty of the tour length, ambiguity of the mission, separation from and limited contact with family and home, austere physical environment, and crowded living conditions in-theater.⁸

The WRAIR in-theater survey results of the 1167 soldiers who had completed questionnaires during November–December 1990 helped to quantify some of the interview observations (Wright et al., 1995). Circumstances experienced during the build-up phase rated by U.S. service personnel as causing “quite a bit (4)” to “extreme (5)” stress, are displayed in Figure 3.2.⁹

With respect to anticipation of combat, results revealed that a substantial proportion of personnel surveyed indicated experiencing high levels of perceived stress. Regarding potential combat, concerns most frequently reported as being highly stressful (as defined by the Combat Anticipation Stress Rating Scale)¹⁰ included anticipation of attack by chemical/biological warfare agents, artillery, air, or armor (Figure 3.3).

Perceived stress concerning combat casualties was also substantial, with significant percentages of personnel rating anticipatory concerns connected with receiving adequate medical care, being killed or wounded, having buddies or leaders killed or wounded, or having to kill or wound enemy troops as causing “quite a bit (4)” or “extreme (5)” stress (Figure 3.4).

⁸A second round of open-ended individual and group interviews were conducted by WRAIR Human Issues Assessment Teams with select combat arms units and with Division Support Command and care personnel in the 82nd Airborne Division, the 101st Airborne division, the 1st Cavalry Division, and the 24th Infantry Division between November 12 and December 6, 1990. This qualitative assessment reports on a similar set of stressors related to the build-up phase (Marlowe et al., 1990).

⁹The survey’s findings also supported some of the clinical observations made by the 528th Medical Detachment regarding family-related stresses. Of 530 soldiers interviewed, 25 percent indicated having moderate to major family problems prior to deployment, 21 percent reported having family problems that required them to be at home, and 7 percent indicated that they had actually requested being sent home to deal with family problems (Wright et al., 1995).

¹⁰WRAIR asked the 1167 soldiers about their pre-combat perceptions regarding combat losses and enemy capabilities. WRAIR developed a Combat Anticipation Stress Rating Scale that was divided into two categories: (a) items concerning enemy assets (e.g., weapons, equipment, systems), and (b) items regarding soldiers’ perceptions relating to casualties and combat losses (e.g., buddy or leader wounded or killed in action; Wright et al., 1995).

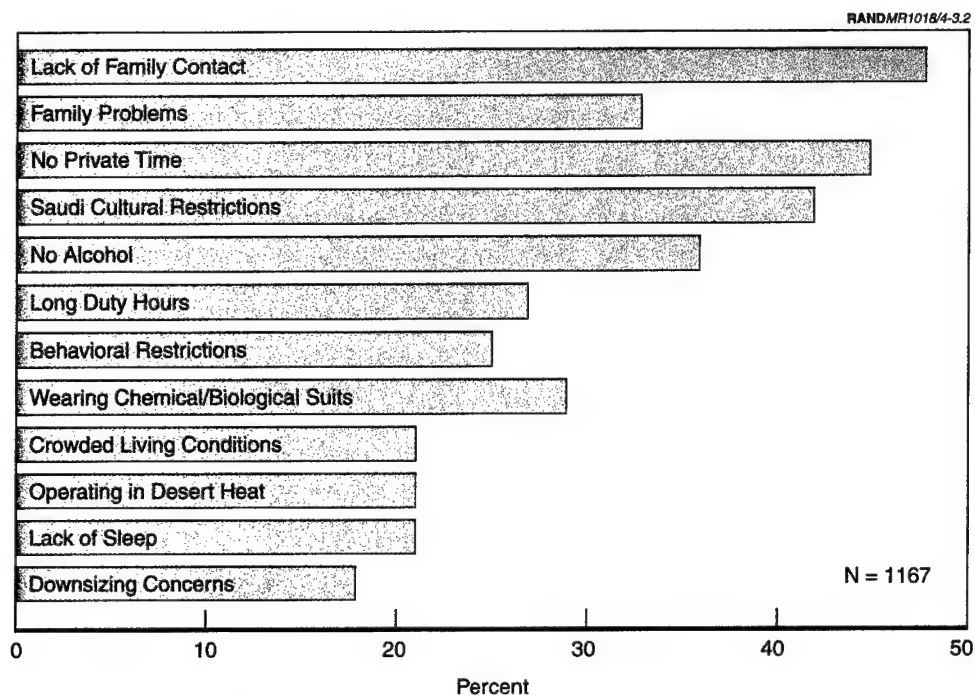


Figure 3.2—Non-Combat Stressors: Build-Up Phase
(Percent of Gulf War Veterans Citing Factor
as Causing “Quite a Bit” or “Extreme” Stress)

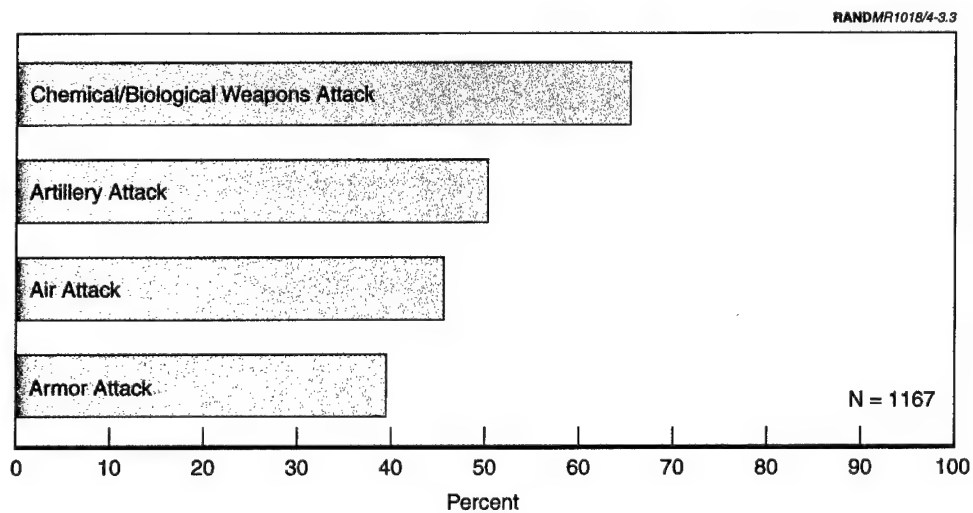


Figure 3.3—Combat Anticipation Stressors: Build-Up Phase
(Percent of Gulf War Veterans Citing Anticipatory Concerns
as Causing “Quite a Bit” or “Extreme” Stress)

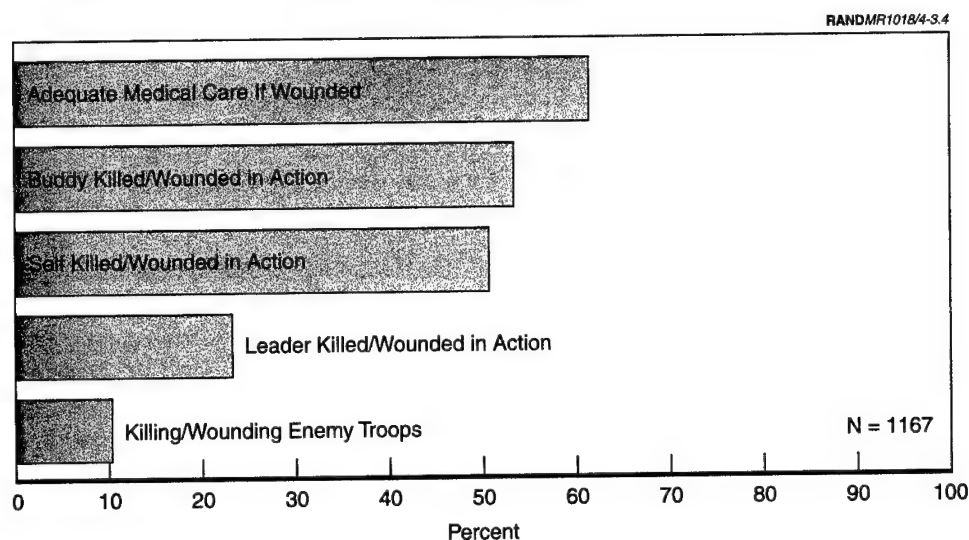


Figure 3.4—Combat Casualty Anticipation Stressors: Build-Up Phase
(Percent of Gulf War Veterans Citing Anticipatory Concerns
as Causing “Quite a Bit” or “Extreme” Stress)

In addition, another WRAIR survey of 748 combat arms soldiers deployed from Germany to Operations Desert Shield and Desert Storm found a similar set of pre-combat concerns regarding a variety of enemy threats. The percentages of soldiers reporting “quite a bit” to “extreme” stress were similar to those reported in Figures 3.3 and 3.4, including the potential use of chemical or biological agents, the possibility that they or a buddy might be wounded or killed in combat, and the possibility of artillery, aircraft, or tank attack (Martin et al., 1992). Importantly, this survey was conducted just several weeks before the ground war and administered to junior and mid-level enlisted soldiers in remote desert staging areas near the Iraqi border; it therefore measures forward deployed combat units’ experiences.

SURVEYS CONDUCTED IN THE IMMEDIATE POST-GULF WAR PERIOD

The Fort Devens Reunion Survey, a prospective study of Gulf War veterans, provided the best source of information concerning stress exposure and perceived stress during the initial days following the return from the Gulf theater (Wolfe et al., 1993). The survey was administered to 2344 veterans who had deployed to the Persian Gulf theater from Fort Devens, MA, within five days of their return to the United States. The sample included service personnel with a wide range of military occupational specialties from more than 45 different

units. It was administered as the units returned to undergo administrative processing. As a result, the survey captured 60–70 percent of those soldiers who had deployed through Fort Devens (Wolfe et al., 1996); however, only 11 percent of respondents were active-duty. Moreover, two-thirds of the active-duty troops surveyed were from Special Forces; thus, the bulk of the survey covered reserve and National Guard personnel.

The Fort Devens survey used both structured and open-ended questions to elicit information about veterans' self-reported exposure to a number of potential stressors. Three assessment instruments were used. The first instrument consisted of a set of combat exposure items involving minor modifications of previously validated combat exposure questions (Gallop et al., 1981). Known as the Laufer combat scale and developed to assess Vietnam combat experiences, this instrument contained items describing exposure to actual combat, such as whether an individual had received friendly or incoming fire; whether his or her unit had been ambushed, attacked, or received sniper fire; and whether he or she had seen either Americans or other troops killed or wounded (Gallop et al., 1981; Wolfe et al., 1993). A second instrument, known as the ODS expanded checklist, consisted of the original Laufer items and 23 additional items pertinent to the Persian Gulf War (e.g., exposure to chemical alert). The ODS expanded checklist was used to create the ODS Combat Exposure Scale. An index of overall war-zone stress exposure was created by adding positively-endorsed items from the Laufer combat and ODS exposure scales. A third instrument asked respondents to describe, in open-ended fashion, the single most distressing incident during deployment.

The survey focused on several stressor categories: (a) wartime activities (e.g., troop engagements); (b) nontraditional wartime events (e.g., combat war-zone events specific to the Gulf War and significant noncombat war-zone occurrences); and (c) non-war-zone, deployment-related experiences (e.g., vocational, domestic, and psychological stressors).

The survey found that approximately two-thirds of the Fort Devens veterans reported very little exposure to combat events as measured by the traditional Laufer combat scale.¹¹ Fifty-six percent of male veterans and 58 percent of female veterans scored in the low range for traditional combat events. Only 3 percent of male veterans and 3 percent of female veterans reported high levels

¹¹Southwick and Morgan (1992) similarly found in their study of 700 Connecticut National Guard personnel and reservists that although combat exposure was relatively limited, anticipation of missile attacks and the possibility of a massive ground war were stressors cited by many of the soldiers. Using the Combat Exposure Scale (CES), they also found that the majority of soldiers reported limited exposure to actual combat-related events.

of exposure to traditional combat activities. No significant differences were found between male and female veterans on mean Laufer combat scores.

Because of the inclusion of ODS-relevant items, the expanded ODS exposure scale yielded higher mean scores than the Laufer combat scale. The ODS exposure scale indicated that the three most commonly endorsed war-zone experiences reported by Fort Devens male and female veterans were:

- alerts of biological or chemical attack (74 percent men; 78 percent women)
- receipt of incoming fire from large arms (74 percent men; 70 percent women)
- witnessing deaths or the disfigurement of enemy troops (50 percent men; 45 percent women).

When asked in open-ended fashion to describe the single most distressing event, men and women veterans reported similar types of events, with the exception that more women reported combat-related concerns as the most stressful experience (Wolfe et al., 1993).¹² For example, approximately 38 percent of men and 48 percent of women reported a combat-related experience as most stressful (e.g., threat of SCUD missile attack); 28 percent of men and 24 percent of women reported noncombat war-zone events as most stressful (e.g., unit member seriously injured or killed in nonmission activity), and 25 percent of men and 20 percent of women reported domestic events as most stressful (e.g., separation from family, family member ill). See Figure 3.5.

Consistent with the above findings are those of Sutker et al. (1993), who surveyed 215 Louisiana Army National Guard and Army Reserve troops activated to service in the Persian Gulf. Four to six months following ODS, these soldiers also were asked in open-ended fashion to list up to three of the most stressful conditions or events experienced during Persian Gulf duty. Content analysis of the written replies identified three major categories of stress: hardships associated with separation from family and home, fear of SCUD-missile and other military attacks, and discomfort related to the austere desert physical environment.

¹²The self-generated stressor categories were based on 300 unique events described by the veterans, including: (a) combat/mission stressors—actual threat to life (e.g., SCUD missile attack, direct exposure to unit member, friend, or civilian being killed or wounded) during mission activity; (2) noncombat, war-zone stressors (e.g., unit member seriously injured or killed in nonmission activity); (3) domestic stressors (e.g., separation from family, family member ill, divorce or legal separation); (4) anticipation of war and combat activities (e.g., SCUD missile alert, fear of biological or chemical attack); (5) physical and situational attributes of the war zone (e.g., communication blockade, severe environmental conditions, continual tour of duty); (6) intra-unit “hassles” (e.g., personal conflict in unit, harassment, leadership failures); and (7) absence of a specific stressor.

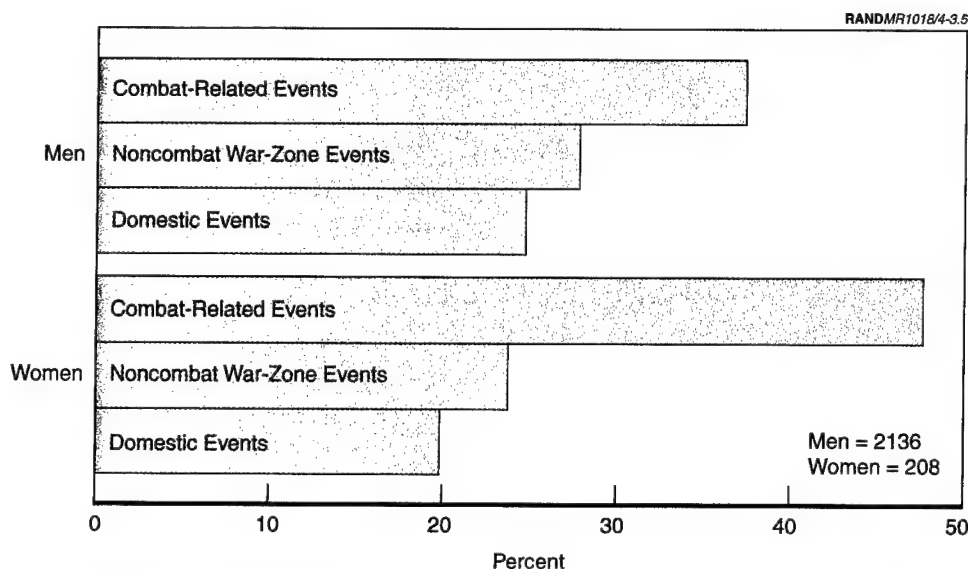


Figure 3.5—Single Most Stressful Gulf War Experience: Ft. Devens Survey
(Percent of Gulf War Veterans Citing Factor as Most Stressful)

Debriefings conducted by the Portland VA Medical Center with a small group of ODS veterans and their spouses (N=80) up to six months following their return from the Persian Gulf also found that important stressors identified included family separation, rapidity of the call-up, hardships associated with the austere desert physical environment, fear of SCUD-missile and other military attacks, and indirect exposure to combat such as being sent into minefields (Ford et al., 1992). In addition, some female veterans reported instances of sexual harassment by allied troops (Ford et al., 1992).

SURVEYS CONDUCTED SEVERAL YEARS FOLLOWING THE GULF WAR

Three key studies evaluated the extent of stress exposure a number of months following the end of the Gulf War.

The Iowa Persian Gulf Study

One survey of Gulf War veterans was conducted five years following ODS (Iowa Persian Gulf Study Group, 1997). This population-based survey of 4886 veterans was designed to assess the prevalence of self-reported symptoms and illnesses among military personnel deployed to the Persian Gulf. However, although veterans were asked about various exposures in the Persian Gulf, of those reported in the literature, only a few categories are relevant here: expo-

sure to psychological stressors, chemical warfare agents, and physical trauma. In general, the study found that National Guard/reserve personnel tended to report greater exposure to these stressors than did regular military personnel. For example, 96 percent of National Guard/reserve personnel (N=911) reported exposure to psychological stressors as compared to 82.6 percent of regular military (N=985). Similarly, more National Guard/reserve personnel than regular military reported exposure to chemical warfare agents (6.4 percent versus 4.6 percent) and physical trauma (5.6 percent versus 3.7 percent).

The Fort Devens Follow-Up Reunion Survey

The follow-up to the initial Fort Devens Reunion Survey occurred in 1993, between 18 and 20 months following these veterans' return to the United States (Wolfe et al., 1996). Of the original 2344 veterans surveyed, 1832 (92 percent men, 8 percent women) participated in the follow-up survey, which consisted of most of the original questions and measures. No significant differences were found in demographic characteristics between the initial and follow-up respondents. The second survey replicated the initial findings. Specifically, a similar set of Gulf War circumstances were widely endorsed as significant sources of perceived stress. The two Fort Devens studies differed, however, in that respondents retrospectively reported higher levels of stress at follow-up than at the initial assessment, a finding consistent with Southwick et al. (1995). Similar increases were found for both men and women.

The WRAIR Study

A second key survey of veterans, conducted two to three years following service in the Gulf War, assessed over 4000 active-duty and reserve personnel from Pennsylvania and Hawaii who had served during Operation Desert Shield/Desert Storm (ODS/S) (Stretch et al., 1995; Stretch et al., 1996a, 1996b; and WRAIR, 1994). Of that sample, 710 active-duty and 764 reserve personnel had deployed in support of Operation Desert Shield/Storm.

The survey compared active-duty and reserve veterans, as well as deployed and nondeployed personnel, with respect to perceived sources of Gulf War theater stress, perceived levels of current stress, causal attributions concerning present problems, and the importance of deployment stressors compared to other recent life events.

Our review of this study focused on deployed personnel and comparisons of active-duty to reserve personnel. As part of the self-administered survey, both deployed active-duty and reservist personnel were asked whether they had experienced various events during their deployment. If they experienced the

event(s), then they were asked the extent to which they found the event or events stressful. An overall finding from this study was that, two to three years following the Gulf War, many veterans rated a number of experiences as being moderately to extremely stressful. The general pattern and magnitude of reported stressors were similar for both active-duty and reserve deployed samples, as summarized below. Moreover, this pattern is similar to the results from the two Ft. Devens surveys that showed a range of stressors, including those associated with combat, exposure to other traumatic wartime events, living and working conditions in-theater, and domestic stressors.

A substantial number of respondents in this study reported combat-related experiences as being moderately to extremely stressful (WRAIR 1994, pp. A-19, A-22):

Reserve Deployed (N=764)

- threat of being killed or wounded (60 percent experienced; of those, 54 percent rated experience as being moderately to extremely stressful)
- exposure to American soldiers killed or wounded (29 percent experienced; of those, 44 percent rated experience as being moderately to extremely stressful)
- exposure to dead or dying (24 percent experienced; of those, 26 percent rated experience as being moderately to extremely stressful).

Active-Duty Deployed (N=710)

- being fired on by the enemy (36 percent experienced; of those, 58 percent rated experience as being moderately to extremely stressful)
- having a buddy wounded or killed in action (15 percent experienced; of those, 34 percent rated experience as being moderately to extremely stressful)
- being wounded or injured (11 percent experienced; of those, 34 percent rated experience as being moderately to extremely stressful)
- having a confirmed kill (10 percent experienced; of those, 23 percent rated experience as being moderately to extremely stressful)
- exposure to American soldiers killed or wounded by friendly fire (20 percent experienced; of those, 43 percent rated experience as being moderately to extremely stressful)
- engaging enemy in a fire fight (18 percent experienced; of those, 43 percent rated experience as being moderately to extremely stressful).

These findings were consistent with those from a separate survey conducted by WRAIR in May 1993 of 5639 Individual Ready Reserve (IRR) soldiers (Stuart and Halverson, 1996).¹³

In terms of exposure to traumatic events, in the WRAIR study of Pennsylvania and Hawaii Gulf War veterans, both deployed active-duty and reserve personnel rated their concerns similarly about the threat of SCUD-missile and chemical-weapons attacks. Eighty-three percent of reserve and 77 percent of active-duty deployed troops experienced the threat of SCUD missile attack. Sixty-nine percent of reserve and 65 percent of deployed active-duty troops rated SCUD missile alerts as being moderately to extremely stressful. Twenty-four percent of reserves and 76 percent of active-duty deployed troops experienced the threat of enemy chemical weapons or agents; approximately 68 percent of these rated this threat as being moderately to extremely stressful.

Waiting for deployment to the Gulf was rated by 72 percent of deployed reserve troops (as compared to 61 percent of deployed active-duty personnel) as being moderately to extremely stressful. Stressors that both groups of deployed troops associated with living and working conditions included: boredom, operating in desert climates, long duty days, extended periods in chemical or biological protective gear, not getting enough sleep, crowding in base camps, lack of private time, and physical workload.

In terms of stressors associated with home, approximately 80-85 percent of active-duty and reserve deployed personnel experienced lack of contact with family and roughly 40 percent reported illness or problems back home. Approximately 70 percent of deployed reservists and 66 percent of deployed active-duty personnel rated lack of contact with family as being moderately to extremely stressful. Approximately half of deployed reserve and active-duty personnel also rated illness or problems back home as being moderately to extremely stressful.

The WRAIR study also attempted to determine current levels of life stress in deployed and nondeployed personnel and to assess the degree to which veter-

¹³In May 1993, WRAIR conducted a survey of 5639 IRR soldiers to assess their experiences of stress or trauma exposure. To measure combat exposure, respondents who had deployed to the Persian Gulf (N=576) were asked whether they had experienced any of 26 combat events during ODS/S and to rate each on a 1-5 point scale as to the degree to which it was perceived as stressful. Similar to the WRAIR study of Pennsylvania and Hawaii Gulf War veterans, a high proportion of the IRR soldiers who had deployed rated a similar set of high-magnitude stressors as being "quite a bit" to "extremely" stressful, including observation of an American soldier or fellow soldier killed in action (70 percent); thoughts of being killed (64 percent); death or wounding of civilians (60 percent); and attack by enemy aircraft, rocket, mortar, or artillery fire (60 percent; Stuart and Halverson, 1996). The most frequent combat events experienced by the IRR were receiving incoming artillery, rocket, or mortar fire (48 percent), seeing an enemy soldier killed or wounded (47 percent), and encountering mines or booby traps (36 percent).

ans attributed their present-day problems to experiences during ODS/S. To address this issue, personnel responded to a checklist of potential life stressors, including the degree of stress they experienced in the past two weeks with respect to each circumstance. In general, results revealed that deployed troops tended to report higher levels of current life stress in a number of domains than did nondeployed personnel. This finding was consistent across both active-duty and reserve personnel.

Veterans were also asked about their present levels of life stress and to indicate what caused most of their recent problems. Deployed troops reported more current concerns than did nondeployed personnel. For example, 40 percent of both deployed active-duty and reserve troops reported at least moderate concern in the past two weeks regarding personal health matters, as compared to 21 percent of nondeployed active duty personnel and reservists. Similarly, approximately 20 percent of active-duty and reserve deployers noted moderate or greater concern in the past two weeks regarding their ODS/S experiences (e.g., thoughts of fellow service personnel being killed or wounded in the Gulf War, or their relationship with their spouse or significant other since their return from Gulf War service).

METHODOLOGICAL LIMITATIONS

The available studies have limitations that hamper drawing definitive conclusions concerning exposure to stressful events during the Gulf War. A key shortcoming is uncertainty as to the general applicability of these data to the broad range of personnel deployed to the Persian Gulf.

Reservations about the lack of general applicability of these findings stem from two primary concerns: low survey-completion rates and nonrandom respondent selection procedures. With respect to survey response rates, some key studies reported levels that only slightly exceeded 30 percent (e.g., WRAIR, 1994). One potential bias associated with low participation is that the surveys may have overrepresented individuals who have been concerned about or who have experienced stress or illness. If this assumption is true, then estimates of self-reported stress exposure and perceived stress could be somewhat inflated.

The partial reliance on retrospective studies and the attendant problem of distorted recall also may have compromised some of these studies. Some evidence suggests, for example, that the perception of stress may become amplified over time (Wolfe et al., 1996), and additional data indicate that recall of exposure to stressful circumstances may be biased in the direction of reporting greater exposure with the passage of time (Southwick et al., 1997). The fact that retrospective recall of perceived stress as well as actual exposure to objective events was greater at follow-up than at the initial assessment is consistent

with the argument that memories of war-related stressors are influenced by intervening events, life changes, and experiences.

With respect to nonrandom respondent selection, most of the available information was derived from combat support and combat service support units, with relatively little representation of combat units. In general, sampling issues call into question the representativeness of study findings. For example, the Fort Devens Reunion Survey appeared largely to have missed combat veterans, sampling mostly those who saw little or no combat. Further, reservists in general were more highly represented than active-duty troops. The lack of data from combat units represents a serious limitation, because these were the units most likely to have been exposed to the high-magnitude stressors.

Moreover, insights gained from in-theater psychiatric evaluations pertain mostly to the staging areas and the build-up phase, where the stressors resulted primarily from coping with family separation, austere and crowded living conditions, uncertainty about the mission, and anticipation of combat. Thus, these assessments offer only a limited picture of the experiences of forward-deployed units or soldiers directly involved in the ground assault.

Another methodological limitation of some studies is that data are collapsed into groups in a manner that obscures potential differences (e.g., CS/CSS and actual combat units are combined, or active-duty and reservist troops are combined). These units would be expected to have vastly different wartime experiences and exposures.

SUMMARY AND CONCLUSIONS

Because of methodological limitations of key studies, we do not know how many Gulf War veterans actually experienced potentially stressful situations. Although not definitive, the available data support the following tentative conclusions:

- Although the Gulf War could be characterized as a brief, brisk action with the air and ground assaults lasting only from January 17, 1991, to February 28, 1991, it was preceded by an abrupt, rapid mobilization and a prolonged build-up phase.
- Deployment to the Persian Gulf theater exposed both combatants and non-combatants to a wide range of stressful circumstances as self-reported by veterans, with stress exposure varying across the different phases of deployment.
- Low-level stress exposures included harsh and crowded living conditions in-theater, long work hours, and uncertain tour length.

- Additional, low-level stressors reported by many Gulf War veterans included concerns regarding separation from family and related problems (e.g., illness in the family, dissolution of a marriage).
- Although exposure to potentially more intense stressors—such as actual combat—was limited, during the six-month build-up phase many Gulf War veterans experienced prolonged anticipation of the risk of serious injury or loss of life due to impending air and ground assaults, as well as to possible chemical-biological warfare and SCUD missile attacks. Other potentially intense stressful events included receipt of incoming fire from large weapons, witnessing the death or disfigurement of American, coalition, or enemy forces, and witnessing other consequences of war such as injured Iraqi or Kurdish civilians.
- Although exposures were not perceived as stressful by all exposed personnel, large numbers of veterans reported experiencing high levels of stress resulting from multiple circumstances. These findings were consistent across studies and over time (e.g., two to three years following the Gulf War).
- Study findings were also consistent for male and female veterans, with few differences found in self-reported exposure between the two groups.
- In comparison to active-duty personnel, reservists—as a group—reported somewhat higher levels of perceived stress, perhaps because of different expectations about military obligations, different levels of preparedness or training, the abrupt and rapid mobilization, and problems in the way they were utilized (e.g., units split apart and individual reservists assigned to other than their parent organization), among other factors.

NON-GULF WAR SCIENTIFIC LITERATURE LINKING STRESS TO HEALTH PROBLEMS

This chapter examines the general literature linking stress to the development of health problems, with the aim of providing a scientific context for subsequent discussion in Chapter Five concerning the empirical literature linking stress exposure to the health problems experienced by veterans of the Persian Gulf War.

The chapter has four sections. In the first section, we review the literature linking stress to psychological health problems. In the second section, we examine evidence linking stress exposure to physical illness and disease, focusing on both stress in general and war-zone exposure in particular. In the third section, we examine the role played by cognitive and social factors in fostering the perception of illness and illness behavior. In the final section, we review factors that may render certain individuals more vulnerable to the potentially negative consequences of exposure to stress.

STRESS AND PSYCHOLOGICAL HEALTH OUTCOMES

In this section, we discuss empirical literature linking stress exposure to poor psychological health. This section also addresses the link between stress and bodily symptoms because psychological and bodily symptoms frequently co-occur, and because much of the literature on the health consequences of stress exposure has not distinguished between the two. In reviewing the literature, we will describe the range, pattern of onset, and temporal course of health consequences associated with stress exposure.

A large body of literature has examined psychological morbidity associated with exposure to stressful life events ranging from financial strain and low socioeconomic status (Lynch, Kaplan, and Salonen, 1997; Pearlin et al., 1981), job loss and unemployment (Brenner and Levi, 1987; Dew, Bromet, and Penkower, 1992), and bereavement (Stroebe and Stroebe, 1993), to civil disturbance

(Hanson, Kilpatrick, Freedy, and Saunders, 1995), natural disaster (Steinglass and Garrity, 1990), technological catastrophe (Baum, Gatchel, and Schaeffer, 1983), and war-zone exposure (e.g., Centers for Disease Control, 1988a; Friedman, Schnurr, and McDonagh-Coyle, 1994; Kaylor, King, and King, 1987; Solomon, 1995b). The empirical literature has traditionally differentiated between ordinary and extraordinary events (e.g., Breslau, 1990), with distinct literatures arising within the two arenas. Whereas ordinary events refer to common stressors faced by virtually everyone at some point in their lives (e.g., harsh living conditions, financial strain, job loss, relationship difficulties, relocation, family illness, and bereavement), extraordinary stressors refer to events that are outside the range of normal human experience (e.g., catastrophic events such as natural and technological disasters, civilian and war-related violence or its often grotesque aftermath).¹ As discussed by others (e.g., Norwood and Ursano, 1996) and in Chapter Three, there is evidence that the Gulf War, like other wars, presented soldiers with an array of stressors of varying nature and magnitude.

What Kind of Stress-Related Health Problems Arise?

The aftermath of exposure to significant stressors, including war zone exposure, ranges from mild to moderate elevations of psychological and somatic (bodily) complaints—including depression, anxiety, hostility, fatigue, appetite disturbance, headaches, back and neck aches, breathing difficulty, gastrointestinal complaints, and sleep problems—to severe forms of psychopathology meeting diagnostic criteria for psychiatric disorders (Adams and Adams, 1984; Baum, Gatchel, and Schaeffer, 1983; Ben-Zur and Zeidner, 1991; Bryant and Harvey, 1996a; Fairley, Langeluddecke, and Tennant, 1986; Gregg, Medley, Fowler-Dixon, Curran, Loughrey, Bell, and Harrison, 1995; Green, Grace, and Gleser, 1985; Phifer, 1990; Shalev, Bleich, and Ursano, 1990; Shore, Vollmer, and Tatum, 1989; Soloman, Mikulincer, and Kotler, 1987; Tranah and Farmer, 1994; Turner, Thompson, and Rosser, 1995; Ursano, Fullerton, Kao, and Bhartiya, 1995; Wilkinson, 1983). Common psychiatric diagnoses reportedly stemming from war zone or other trauma exposure as well as other life events include PTSD and other anxiety disorders, depression, substance abuse, and somatiza-

¹Most conceptual discussions of the two classes of stressful events have implicitly assumed that extraordinary events evoke responses that differ from ordinary events in severity (e.g., March, 1993). In fact, although much empirical research indicates that a dose-response relationship exists between exposure and subsequent morbidity, it is increasingly recognized that only a minority of persons exposed to extraordinary stressors develop serious psychological morbidity (Tomb, 1994), while many persons exposed to ordinary stressors develop symptoms previously believed to affect only those individuals exposed to extraordinary events (Solomon and Canino, 1990). For this reason, some researchers question the utility of drawing sharp distinctions between types of stressful events when seeking to understand their impact.

tion (Bremner, Southwick, Darnell, and Charney, 1996; Brown, Bifulco and Harris, 1987; Canino, Bravo, Rubio-Stipec, and Woodbury, 1990; Friedman, Schnurr, and McDonagh-Coyle, 1994; Green, Lindy, Grace, and Anthony, 1992; McFarlane and Papay, 1992; Smith, Robins, Pryzbeck, Goldring, and Soloman, 1986; van der Kolk, Pelcovitz, Roth, Mandel et al., 1996).

Because a substantial number of veterans of the Gulf War report somatic symptoms as their chief complaints (Institute of Medicine, 1996; Presidential Advisory Committee, 1997), it may be useful to provide some illustrations of research linking stress exposure to bodily symptoms. In one study of the impact of the threat of Iraqi missile attack on Israeli citizens during the Gulf War (Ben-Zur and Zeidner, 1991), 500 Israeli civilians (39 percent men, 61 percent women) were assessed. This study found that a large proportion of the Israeli civilian sample reported experiencing somatic symptoms including fatigue (66 percent), appetite disturbance (62 percent), headaches (60 percent), back-aches/neck ache (37 percent), breathing difficulty (29 percent), and gastrointestinal complaints (24 percent) over a 30-day period (also see Soskolne, Baras, Palti, and Epstein, 1996). These rates were substantially larger than those reported by a comparison group of Israeli citizens studied before the war.

A similar study of persons residing near the site of the Three Mile Island nuclear reactor also attests to the role of stress in provoking somatic symptoms (Davidson and Baum, 1986). Nearly five years after the incident, residents of the area reported more health problems than did control subjects (e.g., headaches, faintness or dizziness, pains in the heart or chest, pains in the lower back, muscle soreness, trouble breathing, hot or cold spells, physical weakness, heavy feelings in arms or legs) as measured by the Symptom Checklist-90 Somatization Scale (Derogatis, 1977) (Davidson and Baum, 1986; also see Dew, Bromet, and Schulberg, 1987).

When Do Health Problems Begin?

The pattern of onset of symptoms and syndromes following stress exposure varies considerably. Although symptom presentation typically begins within days of exposure (e.g., Keane, Pickett, Jepson, McCorkle, and Lowrey, 1994; Nolen-Hoeksema and Morrow, 1991; Ursano, Fullerton, Kao, and Bhartiya, 1995; Weisaeth, 1989), this is not always the case. Clinical case studies—principally focusing on combat veterans, prisoners of war, and holocaust victims—suggest that psychological morbidity may, in some instances, take decades to emerge (Chodoff, 1963; Falk, Hersen, and Van Hasselt, 1994; Herrmann and Eryavec, 1994; Pomerantz, 1991; Ramchandani, 1990; Van Dyke, Zilberg, and McKinnon, 1985). More rigorous empirical studies of both civilian and combat trauma survivors, although few in number, also indicate that psychological

morbidity may have a delayed onset (e.g., Green, Lindy, Grace, Gleser et al., 1990; McFarlane, 1988; Solomon, Kotler, Shalev, and Lin, 1989a). Based on the limited available data, it appears that perhaps as many as 10 percent of cases may experience delayed onset of symptoms ranging from several months to several years. For example, Green et al. (1990) reported that a small number of survivors of a dam collapse experienced delayed onset of symptoms as long as 14 years after the initial incident. Similarly, McFarlane (1988) reported that approximately 10 percent of firefighters exposed to a fire disaster developed clinically significant symptoms between one to two-and-a-half years following the incident. Finally, Solomon et al. (1989a) also reported that a similar percentage of combat veterans reported delayed onset of PTSD from one to five years following combat exposure. The latter research, which dealt with a help-seeking population, also found that a substantial portion of persons who initially appeared to have delayed onset of symptoms were more accurately characterized as having delayed seeking help.

How Long Do Psychological Problems Last?

Most research suggests that psychiatric reactions to relatively circumscribed stressful life events (e.g., accidents and natural disasters) are short-lived, generally disappearing within 6–18 months (Fairley et al., 1986; Keane, Pickett, Jepson, McCorkle, and Lowrey, 1994; Steinglass and Gerrity, 1990; Bravo et al., 1990; Shore, Tatum, and Vollmer, 1986; Tranah and Farmer, 1994). Reactions are not always short-lived, however. Numerous studies attest that stress reactions can persist long after the stressful circumstances themselves have subsided, although persistent problems typically manifest themselves in only a minority of exposed persons. Studies of persons exposed to less-circumscribed events including combat veterans, prisoners of war, and holocaust survivors, indicate that symptoms of stress exposure can persist for decades (Beebe, 1975; Eitinger, 1971; Engdahl, Speed, Eberly, and Schwartz, 1991; Goldstein, van Kammen, Shelly et al., 1987; Hovens, Falger, Op den Velde, Schouten, de Groen, and van Duijn, 1992; Solomon and Kleinsauz, 1996). Other studies indicate that stress reactions can persist for years as well (Baum, Cohen, and Hall, 1993; Green, Lindy, Grace, Gleser et al., 1990; McFarlane, 1988; Winje, 1996). As noted earlier, for example, Davidson and Baum (1986) found that individuals residing near the site of the Three Mile Island incident experienced more intense bodily symptoms, poorer self-rated concentration, higher levels of depression, anger, anxiety, and more interpersonal problems than did control subjects nearly five years after the incident (also see Dew, Bromet, and Schulberg, 1987).

Several recent studies of military veterans suggest that the psychological consequences of combat exposure can persist for decades (Centers for Disease Control, 1988a; Kulka, Schlenker, Fairbank et al., 1990; Lee, Vaillant, Torrey, and

Elder, 1995; O'Toole, Marshall, Grayson et al., 1996a). For example, a survey of a randomly selected sample of Australian Vietnam veterans (N=641) revealed that a degree of self-reported combat exposure, assessed retrospectively, was associated with heightened six-month and lifetime prevalence of various mental health disorders, including alcohol abuse and dependence, PTSD, and somatization disorders. These disorders were, however, not significantly associated with a second index of combat exposure, i.e., whether individuals had been assigned to a combat unit (O'Toole et al., 1996a). Similarly, a large-scale epidemiologic study of Vietnam veterans (N=7924) and Vietnam-era veterans (N=7364) reported that Vietnam veterans suffered from higher rates of current depression (4.5 percent versus 2.3 percent), current anxiety (4.9 percent versus 3.2 percent), and current alcohol abuse or dependence (13.7 percent versus 9.2 percent) (Centers for Disease Control, 1988a). Moreover, a rare 40-year prospective study of a small group of World War II veterans revealed that combat exposure predicted symptoms of PTSD at follow-up in 1988, even after adjusting for other potential confounding factors (Lee et al., 1995). With the exception of the research reported by O'Toole et al., 1996a, these studies did not assess combat or stress exposure per se, leaving open the possibility that apparent influences on health could be attributable to factors other than stress.

STRESS AND PHYSICAL HEALTH OUTCOMES

The literature addressing the link between exposure to stress and physical morbidity is voluminous, consisting of hundreds, if not thousands, of empirical research articles. Because of its size and scope, we present a highly selective review of this literature, divided into three sections. In the first section, we provide an overview of the life events research paradigm, which is the most common methodologic approach to studying the linkage between stress and ill health and disease. In the second section, we provide an illustrative review of the literature linking stress to ill health and disease to provide a sense of the scope of this research. Finally, we discuss research directly bearing on the role of war-zone exposure on subsequent ill health and disease.

Overview

In general, the life-events paradigm seeks to establish a temporal association between the occurrence of stressful events, as assessed by various life event paper-and-pencil checklists or interview-based methods (Turner and Wheaton, 1995; Wethington, Brown, and Kessler, 1995), and the onset of illness or disease. The impact of life events is typically presumed to be additive, with the accumulation of events or the occurrence of particularly extreme events expected to exert greater impact upon health (Rabkin and Struening, 1976).

Although numerous research strategies exist within the life-events tradition, two classes of studies are particularly relevant for current purposes. One class of research studies focuses on persons with specific health problems, seeking to determine whether life events are associated with their onset or course. The typical study of this sort relies on a retrospective design in which persons with a recent onset of a specific disease or illness are compared to a control group of persons without the target disorder. Within this paradigm, both groups of patients are queried as to the number of life events that occurred within a specified time frame (e.g., Ogden, Mee, and Henning, 1993). A second class of studies focuses on persons who have experienced a particular life event (e.g., war-zone exposure), seeking to determine whether these individuals are at greater risk for developing subsequent health problems relative to either a comparison group of unexposed, but otherwise similar, persons (Centers for Disease Control, 1988b) or to data from the general population (e.g., O'Toole, Marshall, Grayson et al., 1996b).

Stress, Ill Health, and Disease

Many reviews of the life-events literature converge in reaching the tentative conclusion that stressful life experiences can serve as one of many risk factors for increasing the likelihood of ill health and disease (e.g., Dohrenwend and Dohrenwend, 1974; Holmes and Masuda, 1974; Rabkin and Struening, 1976). Epidemiologic studies of persons exposed to significant life stressors include social isolation (House, Landis, and Umberson, 1988), bereavement (Stroebe and Stroebe, 1993), unemployment and poor socioeconomic conditions (Catalano and Dooley, 1983; Farrow, 1984; Moser, Fox, and Jones, 1994), and divorce (Lynch, 1977; Verbrugge, 1979), as well as exposure to trauma (Ullman and Siegel, 1996), and wartime service (Elder, Shanahan, and Clipp, 1997; O'Toole, Marshall, Grayson et al., 1996b). These studies suggest that these persons are more likely to develop physical health problems. For example, Ullman and Siegel (1996) examined a random sample of nearly 2500 Los Angeles residents, finding that persons exposed to one or more traumatic event in their lifetimes reported more limited physical functioning and more chronic medical conditions relative to their nonexposed counterparts.

Other recent studies of persons with specific health problems also have provided evidence implicating stress exposure as one of multiple risk factors for numerous disorders including coronary heart disease (Siegrist and Peter, 1996; Steptoe, 1993), certain gastrointestinal disorders, e.g., irritable bowel syndrome (Levy, Cain, Jarrett, Heitkemper, 1997; Whitehead, 1996) and duodenal ulcers (Levenstein and Kaplan, 1998; Levenstein, Pranter, Varvo, Arca et al., 1996;

Raiha, Kemppainen, Kaprio, Koskenvuo, and Sourander, 1998),² acute appendicitis (Beaurepaire, Jones, Eckstein, Smith et al., 1992), metabolic control of diabetes mellitus (Goldston, Kovacs, Obrosky, and Iyengar, 1995), sleep disorders (Partinen, 1994), certain skin conditions (Al'Abadie, Kent, and Gawkrödger, 1994), headaches (Labbe, Murphy, and O'Brien, 1997), and upper respiratory infections (Cohen, Tyrell, and Smith, 1991, 1993; Stone et al., 1992).

Despite numerous positive findings, evidence implicating stress as one of multiple etiologic contributors is more established for some disorders than others. Controversies exist, and interpretation of much of the existing data is impeded by methodological and conceptual inadequacies and inconsistent findings. Many researchers have identified significant shortcomings that hamper the progression of knowledge in the field (e.g., Dohrenwend, Pearlin, Clayton et al., 1982; Depue and Monroe, 1986; House, 1987; Kasl, 1996; Kessler, McGee, and Nelson, 1996; Moos and Swindle, 1990; Rabkin and Struening, 1976; Walker and Katon, 1990). These shortcomings include a simplistic overemphasis on stressful events as a sole cause of disease rather than as one of multiple factors that may alter susceptibility to disease (e.g., Dohrenwend, Pearlin, Clayton et al., 1982; Walker and Katon, 1990). They also include an over-reliance on retrospective rather than prospective research designs (e.g., Depue and Monroe, 1986); a reliance on self-reported, rather than objectively verified, health outcomes; and a failure of studies to differentiate acute from chronic life events (e.g., House, 1987).

In addition, many of the findings from the life-events literature are open to alternative causal interpretations due to the nonexperimental nature of the life-events paradigm. For example, in a recent study of the link between the social stress of unemployment and poor health, it is difficult to disentangle whether ill health or disease is a cause or a consequence of stress (Moser, Fox, and Jones, 1994). Finally, even in those instances in which the direction of causality seems evident, life-event studies are often silent as to the mechanisms that might explain the putative relationship between stress exposure and ill health or disease.

²In recent years, the contribution of stress as a causal factor in the etiology of ulcers has fallen into disrepute with the discovery of the role of *Helicobacter pylori* bacteria. This controversy serves to highlight the complicated role of stress as one of multiple possible etiological factors in the cause of disease and ill health, as researchers are beginning to observe that *Helicobacter pylori* is unlikely to be an adequate monocausal explanation for ulcer disease (Levenstein, 1998; Melamed and Gelpin, 1996).

War-Zone Exposure, Ill Health, and Disease

With respect to war-zone exposure, several recent epidemiologic studies have linked exposure to ill health and/or disease. For example, in a recent epidemiologic study of a random sample survey of Australian Vietnam veterans (N=641), participants reported greater health service utilization and greater-than-expected prevalence rates for numerous health problems relative to their rates in the general population (O'Toole et al., 1996b). Moreover, degree of combat exposure itself, as measured by a 21-item self-report index, was significantly associated with self-reports of recent and lifetime health problems, including recent hernia and chronic ulcers, recent eczema and chronic rashes, hearing loss, chronic infective and parasitic disease, chronic back disorders, and other symptoms, signs, and ill-defined conditions (O'Toole et al., 1996b; also see Taft, Stern, King, and King, in press).

A potentially more objective index of combat exposure, i.e., comparing veterans assigned to combat units with those who were not, found comparatively few differences between the two groups. Similar research focusing on American Vietnam veterans has revealed self-reported differences with respect to physical health status, few of which were borne out by objective medical examination (Centers for Disease Control, 1988b; Kulka, Schlenger, Fairbank et al., 1990). For example, an epidemiologic study of a random sample of enlisted personnel who served in Vietnam (N=7924) and a comparison group of Vietnam-era veterans who did not serve there (N=7364) found that Vietnam veterans reported more current and past health problems, including limitations in activities, greater medication use, somatic symptoms, deafness, hypertension, skin conditions, ulcers, hepatitis, liver conditions, and urinary tract problems among other problems. Objective medical examination of a subsample of Vietnam veterans was unable to substantiate most of the self-reported problems experienced by Vietnam veterans, except that they had more signs of deafness, lower sperm concentrations, and a higher prevalence of hepatitis B antibodies (Centers for Disease Control, 1988b).

With the exception of the Australian study, these studies did not assess stress exposure per se, thus leaving open the possibility that observed differences could be attributable to factors other than stress itself. Similarly, although suggestive evidence points to combat exposure as a risk factor for physical decline and even early mortality (Elder et al., 1997), it is unclear whether these findings are attributable to combat stress itself, to some other exposure associated with the combat experience, or to some as yet undetermined factor.

Although PTSD is not classified as a physical disease, studies of combat veterans with documented PTSD typically report that the disorder is associated with greater subjective impairment in health status and more self-reported physical

symptoms, without detectable differences in physical health status upon physical or laboratory examination (e.g., Litz, Keane, Fisher, Marx, and Monoco, 1992; Shalev, Bleich, and Ursano, 1990). A more recent epidemiologic study relying on chart review did report, however, that Vietnam veterans with PTSD are at greater risk of various objectively defined physical diseases than are their counterparts without PTSD (Boscarino, 1997). Specifically, in a randomized study, Boscarino examined the medical histories of 1399 male Vietnam veterans approximately 20 years after combat exposure, comparing persons with a diagnosis of PTSD to their counterparts without PTSD. Boscarino controlled for preservice, in-service, and postservice factors (including intelligence, race, region of birth, enlistment status, volunteer status, Army marital status, Army medical profile, hypochondriasis, age, smoking history, substance abuse, education, and income). Associations with PTSD were found for reported circulatory, digestive, musculoskeletal, metabolic, nervous system, respiratory, and nonsexually transmitted infectious diseases as determined by medical record abstraction. These findings led the author to conclude that there is a direct link among combat stress exposure, PTSD, and a broad spectrum of human diseases.

COGNITIVE AND SOCIAL FACTORS IN THE PERCEPTION OF ILLNESS AND ILLNESS BEHAVIOR

In this section, we briefly discuss empirical literature bearing on how cognitive and social factors might promote illness behavior and the perception of oneself as ill even in the absence of an actual organically based medical disorder. As noted elsewhere, a significant number of Gulf War veterans are experiencing health problems for which there is, as yet, no clear anatomical basis. This phenomenon is also true of the general population, with research indicating that a substantial portion of individuals seeking general medical care do so for somatic symptoms that have no clear organic cause (e.g., Barsky and Borus, 1995; Kroenke and Price, 1993; Kroenke and Mangelsdorff, 1989). Recent estimates suggest that 40–60 percent of patients in primary care practice present with symptoms that have no detectable organic origins (Barsky and Borus, 1995). In one study of primary care active-duty and retired personnel and their dependents, only 16 percent of persons reporting with one or more of 14 common health complaints³ were identified as having complaints with a physical etiology (Kroenke and Mangelsdorff, 1989).

Although it is a virtual certainty that some persons presenting with complaints of unknown origin are, in fact, suffering from organically based medical disorder-

³Chest pain, fatigue, dizziness, headache, edema, back pain, dyspnea, insomnia, abdominal pain, numbness, impotence, weight loss, cough, and constipation.

ders, there is increasing awareness that both medical help-seeking and the perception of oneself as ill are influenced by cognitive and social processes that may not be strongly related to actual disease (e.g., Cioffi, 1991; Mechanic, 1972; Pennebaker, 1982). Under stress, individuals may be more likely to attend to normal bodily sensations that might otherwise go unnoticed (Mechanic, 1972; Pennebaker, 1982). In addition, there is evidence that negative moods, such as those commonly precipitated by stressful circumstances, may actually lead to biased perceptions of one's physical health status (Goldman, Kraemer, and Salovey, 1996; Salovey and Birnbaum, 1989). For example, Salovey and Birnbaum (1989) studied persons with minor cold and flu symptoms, experimentally manipulating their moods in a laboratory setting. This research found that persons induced to experience sad moods reported more aches, pains, and bodily discomfort than did persons who had been induced to experience happy moods.

Additional research converges in suggesting that certain individuals may be predisposed to experience more somatic distress than others, even in the absence of organic disease (Costa and McCrae, 1985, 1987; Kirmayer, Robbins, and Paris, 1994; Watson and Pennebaker, 1989). This tendency may be due to individual differences in sensory amplification, i.e., the inclination to interpret bodily sensations as intense and disturbing (Barsky, 1992; Barsky, Goodson, Lane, and Cleary, 1988; Haenen, Schmidt, Schoenmakers, and van den Hout, 1997). Most importantly, this tendency to experience bodily distress appears to be exacerbated by stressful conditions (e.g., Barsky et al., 1988; Barsky, Ahern, Bailey, and Delamater, 1996). For example, a prospective study of individuals referred for electrocardiographic monitoring of heart palpitations (Barsky et al., 1996) reported that persistent palpitations and frequency of unscheduled medical visits were more common among individuals who both were highly sensitive to bodily sensations and had experienced a greater number of minor daily hassles.

Another social phenomenon of potential relevance has been variously referred to as hysterical contagion or mass psychogenic illness. Numerous cases of this epidemic phenomenon have been reported (e.g., Alexander and Fedoruk, 1986; Colligan and Smith, 1978; Hefez, 1985; Gamino, Elkins, and Hackney, 1989; Kerckoff and Back, 1968; Rockney and Lemke, 1992; Small and Borus, 1983; Smith, Colligan, and Hurrell, 1978; Stahl and Lebedun, 1974). This phenomenon has been defined as "the occurrence in a group of people of a constellation of physical symptoms suggesting an organic illness but resulting from a psychological cause, with each member of the group experiencing one or more symptoms" (Small and Borus, 1983; p. 632). These sudden outbreaks of illness are often associated with periods of uncertainty and social stress.

The nature of this social-contagion phenomenon, and the mechanisms by which it is spread, are not fully understood, although the role of the media as a transmitting agent has been highlighted in some accounts (e.g. Hefez, 1985). These epidemics typically spread rapidly and resolve quickly, although controversy usually persists concerning the etiology of these outbreaks. Other characteristic features of mass psychogenic illness include the absence of abnormal laboratory results or physical findings to confirm a specific organic cause and evidence of atypical physical or psychological stress (Rockney and Lemke, 1992). The symptoms of mass psychogenic illness are remarkably similar across case reports, with primary symptoms including dizziness, headaches, nausea, shortness of breath, hyperventilation, and abdominal pain (e.g., Alexander and Fedoruk, 1986; Rockney and Lemke, 1992; Small and Borus, 1983). Although little or no evidence exists that this phenomenon played a contributory role in the bodily symptoms of Gulf War veterans, social modeling via the media is recognized as a significant determinant of behavior (e.g., Bandura, 1994), and mass hysteria has been invoked to explain the health problems of veterans of the Gulf War (Showalter, 1997). One typical feature of mass hysteria that seems somewhat inconsistent with its application to the health problems of Gulf War veterans is that the vast majority of cases documented in the scientific literature involve school-age children or women.

STRESS VULNERABILITY AND RESISTANCE

Reviews of the general literature linking stressful life circumstances to mental and physical health problems suggest that stress exposure, in itself, accounts for only about 10 percent of the variability in whether individuals develop health problems (Rabkin and Struening, 1976; Thoits, 1983). It is also clear that virtually no stressor, however severe, produces health problems in every exposed person, raising interest in identifying preexisting vulnerabilities that may place certain individuals at greater risk for susceptibility to health problems. The empirical literature has implicated several risk factors. These factors include genetic or other biological predispositions (Kendler, 1995; McEwen and Stellar, 1993; Steptoe, 1991). For example, one study of male monozygotic twins who were either in Vietnam or Vietnam-era veterans found that genetic factors explained about 30 percent of PTSD symptoms, even after controlling for actual war-zone exposure (True, Rice, Eisen et al., 1993).

Prior life experiences also appear to play a role in individual adjustment to stressful life encounters. Previous exposure to negative life events, including trauma, appears to increase susceptibility to mental health problems (e.g., Kessler, Davis, Kendler, 1997; King, King, Foy, and Gudanowski, 1996; Resnick, Kilpatrick, Best, and Kramer, 1992; Solomon, 1995a; Turner and Lloyd, 1995). For example, Turner and Lloyd (1995) conducted face-to-face interviews with

nearly 1400 community residents, reporting a relationship between cumulative lifetime trauma exposure and subsequent psychological distress and disorder. Similarly, the presence of other contemporaneous or subsequent life stressors (Bryant and Harvey, 1986b; Green and Berlin, 1987; McFarlane, 1989; Solomon, Mikulincer, and Flum, 1988; Solomon, Mikulincer, and Flum, 1989b) increases the risk of adverse health consequences. However, prior successful experiences with stressful encounters (Dienstbier, 1989) and appropriate training and preparation for stress exposure (Marmar, Weiss, Metzler, Ronfeldt, and Foreman, 1996) have been shown to predict later successful adjustment to stressful events.

Personal and social factors also have been identified as moderating the influence of stress on health. Whereas certain coping resources such as personality traits (e.g., optimism and hardiness) and the availability of cohesive or socially supportive interpersonal networks (Cohen and Edwards, 1989; Florian, Mikulincer, and Taubman, 1995; Kessler, Price, and Wortman, 1985) appear to provide stress resistance, the presence of other personality or psychobiological factors may increase the likelihood that negative health consequences will follow from stress exposure (Barsky, Goodson, Lane, and Cleary, 1988; Lewis, Thomas, and Worobey, 1990). Numerous studies suggest that neuroticism—the tendency to experience chronic emotional and cognitive distress—may serve as a risk factor for the development of PTSD or psychological distress following exposure to stressful life events (e.g., Breslau, Davis, Andreski, and Peterson, 1991; Carr, Lewin, Webster, Hazell, Kenardy, and Carter, 1995; Tranah and Farmer, 1994; Turner, Thompson, and Rosser, 1995). For example, Breslau et al. (1991) found that neuroticism increased one's risk for PTSD following exposure to a traumatic event. Some research suggests that exposure to life events might act to trigger or substantially advance the onset of problems in predisposed individuals that might have developed at a later date had exposure not occurred (see Brown and Harris, 1978, for discussion). Although many of these studies are limited inasmuch as predisposing personal or social factors are assessed after—rather than prior to—stress exposure, more recent research suggests that neuroticism prospectively predicts exposure to traumatic events and, therefore, greater risk for PTSD (Breslau, Davis, and Andreski, 1995).

Preexisting history of psychiatric illness has also been shown to be an important risk factor for the development of stress-related illness. For example, the National Vietnam Veterans Readjustment Study, a national probability sample of over 1500 veterans, found that the existence of psychiatric symptoms prior to exposure was a significant risk factor for the development of PTSD (Kulka, Schlenger, Fairbank, Jordan, Hough, Marmar, and Weiss, 1991). Similarly, Breslau, Davis, Andreski, Peterson, and Schultz (1997) conducted diagnostic interviews with a random sample of over 1000 young adults, reporting that pre-

existing anxiety and depressive disorders were significant risk factors for the onset of PTSD following exposure to a traumatic life event. Furthermore, in analyses of data from the National Comorbidity Study, Bromet, Sonnega, and Kessler (1998) found that a preexisting history of affective disorder predicted PTSD in women, and a history of anxiety disorder predicted PTSD in men.

Finally, for reasons that are not fully understood, research also indicates that members of particular groups (e.g., females, minorities, and persons of low socioeconomic status) are, in general, more vulnerable to stressful life circumstances (e.g., Kessler and Neighbors, 1986; McLeod and Kessler, 1990; Roxburgh, 1996). With respect to gender, for example, Breslau et al. (1997) reported that the prevalence of PTSD was considerably higher for women than for men exposed to traumatic events. Similarly, using a stratified random sample of over 3000 community residents, Carr et al. (1995) reported that females experienced greater postdisaster psychological distress six months following earthquake exposure. With respect to race and socioeconomic status (SES), for example, using data from an epidemiologic survey of over 2000 community-residing adults, Ulbrich, Warheit, and Zimmerman (1989) found that ethnicity and SES jointly determined reactions to undesirable life events such that low-SES African-Americans were more susceptible to psychological distress than were their low-SES white counterparts.

SUMMARY AND CONCLUSIONS

This chapter arrives at the following key conclusions:

- The empirical literature provides evidence that exposure to stressful events—including combat or war-zone exposure—can contribute to various psychological or bodily symptoms. Relatively common symptoms include depression, anxiety, fatigue, impaired memory and concentration, headaches, back and neck aches, gastrointestinal complaints, and breathing difficulty. More severe forms of psychiatric disorder, including PTSD, have also been linked to exposure to stressful life events. The onset and duration of these problems vary, with some individuals reporting delayed onset of symptoms or delayed treatment-seeking. Although they generally dissipate over time, it is not uncommon for symptoms of psychological or bodily distress to persist for years. In many instances, what appears as delayed onset of symptoms may be more aptly characterized as delayed help-seeking.
- The empirical literature also suggests that stress exposure acts as a contributing risk factor for a broad range of physical illness and disease, although the strength of the evidence is generally modest and varies depending upon the disorder in question. Some epidemiologic studies, a

few of which are large and well-controlled, are consistent with the possibility that combat or war-zone exposure may contribute to greater prevalence of self-reported chronic health problems, perceived poor health, and higher levels of help-seeking behavior. Less evidence implicates combat or war-zone exposure in actual physical disease.

- The empirical literature indicates that self-reported health complaints in the absence of objectively verifiable disease is relatively common in the general population. Some evidence suggests that stress exposure and perceived stress, as well as psychological and social processes, may contribute to both medical help-seeking behavior and the experience of oneself as ill, even in the absence of objective evidence of disease.
- Finally, evidence suggests that virtually no stressful event or set of stressful circumstances produces health problems in every exposed individual. Indeed, stress might best be viewed as a co-factor interacting with various other host vulnerability and resistance factors—including prior life experiences, genetic or biologic predispositions, personality factors, and coping resources—to increase the likelihood of illness and disease.

GULF WAR SCIENTIFIC LITERATURE LINKING STRESS TO HEALTH PROBLEMS

OVERVIEW

This chapter evaluates available data bearing directly on the possible role of exposure to potentially stressful conditions as an etiologic factor in the health problems of veterans of the Persian Gulf War. After describing our method for identifying relevant studies and briefly characterizing different approaches used by these studies to measure stress exposure and health outcomes, this chapter will evaluate the extent to which study findings support a link between stress exposure and subsequent health problems. Following the organizational structure of Chapter Four, discussion of the literature will first focus on the studies linking stress to mental health outcomes. No studies were found linking stress to physical disease *per se*, although a few studies examined the relationship between stress and bodily symptoms that might be due to either physical or mental conditions. As in Chapter Four, we provide a brief review of evidence pertaining to whether certain individuals or groups were at greater risk for developing stress-related health problems. However, we found no Gulf War-specific studies that expressly addressed whether stress exposure fostered the perception of illness or illness behavior. So, unlike Chapter Four, this chapter does not address that topic.

STUDY SELECTION CRITERIA

We identified 34 studies relevant to a possible link between exposure to potentially stressful conditions in the Gulf War and symptoms experienced by returning Gulf War veterans. Studies met each of the following criteria. First, we required that studies include a measure of stress exposure as defined by self-report or documented exposure to potentially stressful conditions (e.g., graves registration duty). Thus, we excluded from this chapter those studies that relied solely on a comparison of deployed versus nondeployed personnel (e.g., Gray et

al., 1996, Hammelman, 1995; Kang and Bullman, 1996; Pierce, 1997; Pontius et al., 1992; Rodell et al., 1992; Ross and Wonders, 1993; Rothberg et al., 1994). Deployment was associated with a number of potentially stressful situations, as discussed briefly in Chapter Three. Similarly, comparisons of deployed and nondeployed troops revealed increased symptoms in deployed personnel, as described in the introduction. Nonetheless, troops may have been exposed to other potentially health-impairing agents such as chemicals or biological weapons, depleted uranium, smoke from oil well fires, pesticides, insect repellents, prophylactic drugs, and infectious diseases (for discussion, see Presidential Advisory Committee, 1996). Unless these other variables are ruled out as explanatory factors, increased symptom levels in deployed troops relative to nondeployed personnel cannot be used to implicate stress by itself. Second, we required that studies include at least one health outcome measure. Finally, with the exception of one British study (Deahl et al., 1994), we required that studies include U.S. Gulf War veterans, as opposed to other participating allied forces, Israeli citizens, or populations indigenous to the Persian Gulf. We reviewed each study design to determine the extent to which valid inferences concerning stress and health could be made from the data. In particular, we evaluated sampling procedures and associated biases that might have resulted.

HOW STRESS EXPOSURE WAS MEASURED

Most studies that we reviewed measured stress exposure in at least one of the following ways: (1) by asking for self-reported stress exposure as part of a structured interview or self-administered questionnaire, or (2) by identifying soldiers who experienced situations that were considered to be potentially very stressful (e.g., witnessing deaths from friendly fire, handling human remains). Most of the self-reported stress-exposure studies used traditional measures of combat exposure that may not have been sufficiently sensitive to noncombat war-zone events that, as shown in Chapter Three, have also been recognized as significant sources of stress. Studies of personnel with documented exposure to potentially stressful events provide the strongest evidence of a link between stress and health problems. However, to the extent that these studies focus on relatively rare and extreme events affecting comparatively few individuals (e.g., being subjected to a SCUD-missile attack), results may be less generalizable to the majority of Gulf War veterans.

HOW HEALTH OUTCOMES WERE MEASURED

Virtually all studies examining the link between stress exposure and health measured outcomes in terms of self-reported psychological or bodily symptoms. Psychological diagnoses were rarely established via interview, even

though accurate classification of individuals as manifesting mental disorders requires a formal assessment using a diagnostic interview. Similarly, physical diagnoses or symptoms were rarely assessed by actual clinical tests or laboratory results. These limitations compromise the ability of these data to yield definitive evidence that stress exposure is linked to verified psychiatric or physical disease. Nonetheless, since stress-related reactions take many forms, including self-reported psychological or bodily symptoms that may not exceed thresholds for disease, these studies are pertinent to evaluating the possible link between stress exposure and poor health.

STRESS EXPOSURE AND MENTAL HEALTH OUTCOMES

Of the studies we identified, more than 80 percent focused on the link between stress in the Gulf War and PTSD or PTSD-like symptoms, an emphasis perhaps attributable to the legacy of Vietnam and the associated importance of PTSD in that war. Because of the large number of studies focusing on PTSD and the fact that PTSD itself is regarded as uniquely attributable to stress exposure, our review of the mental health literature distinguishes between findings relevant to PTSD symptoms and findings concerning other mental health symptoms.

Gulf War Stress Exposure and PTSD

What Is PTSD? PTSD is an anxiety disorder associated with the experience of a traumatic event. According to the Diagnostic and Statistical Manual of Mental Disorders—Fourth Edition (DSM-IV; APA, 1994), an event qualifies as a trauma capable of producing PTSD if it involves experiencing, witnessing, or receiving news about a situation that involved actual or threatened death or serious injury, or a threat to physical integrity. The person's response to the event must also involve intense fear, hopelessness, or horror. PTSD is characterized by three types of symptoms: (1) re-experiencing of the event (e.g., nightmares, flashbacks), (2) avoidance of stimuli associated with the trauma and a numbing of general responsiveness, and (3) increased arousal. To meet diagnostic criteria, core symptoms must persist for at least one month and cause clinically significant impairment in social, occupational or other important areas of functioning. Some symptoms of PTSD overlap with other psychological and bodily symptoms reported by CCEP and VA-registry soldiers (e.g., sleep disturbance, difficulty concentrating, and memory loss).

What Are the Rates of PTSD in Persian Gulf War Veterans? Several large studies examined the rates of PTSD diagnoses in samples of Persian Gulf War (PGW) veterans (e.g., Iowa Persian Gulf Study Group, 1997; WRAIR, 1994). In the Iowa Study, 1.9 percent of deployed regular military personnel had symptoms of PTSD (as measured by the PTSD checklist) compared with only 0.7 percent of

nondeployed. Comparable estimates for deployed and nondeployed National Guard/reservists were 2.0 percent and 1.1 percent respectively (Iowa Persian Gulf Study Group, 1997). Overall, observed rates of PTSD in other studies of active-duty troops or reservists found rates of PTSD under 10 percent (see Appendix A, Table A.1), although some of the studies of samples that experienced verifiable combat-related events, such as graves registration duty, reported higher rates of PTSD (the highest being 46 percent, Sutker et al., 1994).

While rates of PTSD were high in a few samples of Gulf War veterans exposed to combat-related events, the data most generalizable to the entire population of Gulf War veterans suggest that PTSD rates are relatively low overall, and substantially lower than those for Vietnam veterans (CDC, 1988a; Kulka, Schlenger, Fairbank et al., 1990). To place these rates in context, the lifetime prevalence of PTSD disorder in the general population is approximately 7.8 percent (Kessler et al., 1995).

Types of Studies. Twenty-seven studies that met our criteria reported on PTSD-related outcomes. The key features of these studies are summarized in Appendix A. For heuristic purposes, we classified the studies into two broad categories. The first class of studies focused on large samples (1000-plus) of veterans of the Persian Gulf War (including both reservists and active-duty personnel), to examine the prevalence of PTSD after Persian Gulf deployment, or to address specific relationships between war-related physical injury or illness and psychiatric symptoms. Five studies fit into this category. A second general category, consisting of 22 studies, incorporated smaller samples of special populations and examined the prevalence of PTSD symptoms in putatively at-risk populations (e.g., troops assigned to graves registrations duty, reservists, and clinical populations of help-seeking veterans after the war).

How PTSD Symptoms Were Measured. Although administration of a diagnostic interview is the most reliable and valid means of establishing a diagnosis of PTSD, a number of self-administered questionnaires have been developed that provide some information about PTSD symptoms. The brevity and ease of administration of these scales render them valuable for use in situations in which it is not feasible to conduct a lengthy diagnostic interview. At the same time, these self-administered scales are not characterized by the precision of a diagnostic interview.

The Mississippi Scale for Combat-Related PTSD was used most frequently to assess PTSD or PTSD symptoms (in 14 of the 27 studies). This scale is a self-report scale developed expressly for use with persons exposed to combat-related trauma (Keane, Caddell, and Taylor, 1988) and originally designed for use with veterans of Vietnam; it was adapted for use with veterans of the Persian Gulf War (e.g., Engel et al., 1993). One problem with this measure is

that an individual could have an elevated score without having experienced a trauma, because some of the items assess symptoms that are not unique to a PTSD diagnosis. Sample items in the scale include "unexpected noises make me jump," and "I am afraid to go to sleep at night." The Impact of Events Scale (IES), another widely used self-administered scale included in eight of the 27 studies, assesses the presence and severity of symptoms of intrusion (e.g., "I had dreams about it") and avoidance (e.g., "I tried not to think about it") but not hyperarousal symptoms. Thus, the IES does not capture the full range of symptoms required for a diagnosis of PTSD. In only two cases (Sutker et al., 1994a, 1994b) were diagnostic instruments administered by a trained interviewer used to assess PTSD.

Findings. Five large-sample studies (see Table 5.1) reported analyses that directly examine the relationship between exposure to stress during the war and subsequent symptoms of PTSD (Adler, Vaitkus, and Martin, 1996; Iowa Persian Gulf Study Group, 1997; Stretch et al., 1996; WRAIR, 1994; Wolfe, Brown, and Kelley, 1993; Wolfe, Keane, and Young, 1996). Four of the five relevant studies demonstrated a clear link between extent of exposure to stress during the war and PTSD symptoms. For instance, in the study published by Stretch et al. (1996; previously published by WRAIR, 1994), IES scores were correlated most highly with combat exposure and the intensity of the respondent's reaction to some combat situations. Five items in particular explained about 28 percent of the variance for the IES avoidance subscale (noise from guns or artillery; exposure to dead or dying bodies; threat of enemy chemical weapons or agents; threat of terrorist attack; and threat of SCUDs).

In addition, noncombat war zone stressors (e.g., crowding in base camps) were also important in explaining some of the variance in IES scores. Fewer soldiers had high IES scores in a second group tested in 1993 than in the group tested in 1991–1992, possibly reflecting attenuation of symptoms with the passage of time. The fifth study (Iowa Persian Gulf Study Group, 1997) was not able to establish a unique link between any specific self-reported exposure (including psychological stress and physical trauma) and symptoms, but noted that most exposure measures were associated with many of the health outcomes. The report did not present any stress-specific analyses related to PTSD, however.

Twenty-two studies examined populations thought to be at risk for PTSD (e.g., reservists, troops assigned to graves-registration duty, troops who experienced front-line combat or suffered physical injuries, and treatment-seekers after return from the war). However, nine of these studies did not analyze the link between stress exposure and subsequent PTSD symptoms (Ford et al., 1992; Haley, Kurt, and Horn, 1997; Sloan et al., 1995a, 1995b, 1996; Sutker et al.,

1994a, 1995a, 1995b; Unger et al., 1992). One additional study assessed PTSD retrospectively by asking graves-registration veterans three to five months after the war to recall their symptoms at the height of the war. This study did not include a measure of symptoms after the war ended (McCarroll et al., 1993a). Finally, one study conducted analyses to examine a link between war-zone stress and the diagnosis of any Axis-I disorder, including PTSD, but did not report specific analyses linking stress to PTSD itself (Brandt et al., 1997). Because both of the latter reports presented data linking stress exposure and other, non-PTSD mental health problems, they will be discussed in the section to follow.

Of the remaining 11 studies, each found a significant relationship between exposure to stressors during the war and subsequent PTSD symptoms (Baker et al., 1992; Deahl et al., 1994; Engel et al., 1993; McCarroll et al., 1995a; Perconte et al., 1993a, 1993b; Sohler et al., 1992; Southwick et al., 1993, 1995; Sutker et al., 1993, 1994b). Some of these studies were correlational. For example, Baker et al. (1992) reported a positive correlation between self-reported combat stressors and PTSD symptoms measured on the IES two to five months after the war among 325 Reservists deployed to the Gulf. Others compared deployed troops with differing levels of stress exposure. For example, troops who were on-site during the SCUD missile attack in Dhahran, Saudi Arabia, had elevated levels of PTSD symptoms compared to those on guard duty three to five miles away (Perconte et al., 1993a). Although the strength of the association varied across studies, the linkages tended to be modest (e.g., correlations = .20-.40). Interestingly, among graves-registration troops with no direct combat exposure, the perception of life threat during the war predicted greater symptoms nine months after the war compared to those who did not perceive life threat (Deahl et al., 1994). As discussed in Chapters Two and Four, this finding is consistent with much theory and research concerning stress. In particular, perceived life threat, as well as actual exposure, is a potent predictor of subsequent adjustment.

Summary. All of the studies that examined the link between exposure to stressors during the Persian Gulf War and symptoms of PTSD found evidence of a positive—albeit modest—relationship between these two factors. Despite this uniform finding, the studies suffer from methodological problems that hamper definitive conclusions regarding the role of stress exposure as a factor in the health problems of Gulf War veterans. These methodological problems will be discussed at the end of the chapter. Given the relatively low incidence of PTSD in veterans of the Gulf War, it does not appear that PTSD, as it is currently defined, can be invoked as a sufficient explanation of the unexplained symptoms of Gulf War veterans.

GULF WAR-RELATED STRESS EXPOSURE AND OTHER MENTAL HEALTH OUTCOMES

Twenty studies, some of which also assessed PTSD outcomes, were identified that examined mental health outcomes other than PTSD. The characteristics of these studies are summarized in Appendix A, Table A.2.

Types of Studies. The 20 studies that measured both stress exposure and mental health outcomes were divided into two groups as in the section above: four large sample studies and 16 smaller studies that examined symptoms in at-risk populations. Study designs varied depending on the purpose of the study. The majority of studies focused on the impact of specific exposures on psychiatric symptoms among Gulf War veterans. A few studies were primarily clinical or treatment evaluations for which control samples were not used (e.g., Baker et al., 1992; Ford et al., 1992; Perconte et al., 1993a).

How Mental Health Outcomes Were Measured. As with the empirical research focusing on PTSD, with few exceptions (e.g., Sutker et al., 1994a), all of the studies examining other types of mental health problems employed self-report checklists of psychiatric symptoms rather than diagnostic interviews. The well-validated Hopkins Symptom Checklist SCL-90 (SCL-90; Derogatis, 1983) and its variant (i.e., the Brief Symptom Inventory (BSI); Derogatis and Spencer, 1982) were the most commonly used psychiatric self-report measures. These instruments include subscales assessing various symptoms of psychiatric conditions (e.g., somatization, obsessive-compulsive disorder, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation, and psychoticism) and yield domain-specific as well as overall measures of psychopathology. Other well-validated instruments included the State-Trait Anxiety Inventory (STAI), a 40-item measure of anxiety (Spielberger, Gorsuch, and Lushene 1970), the Beck Depression Inventory (BDI), a 21-item measure of depression (Beck et al., 1961), and the General Health Questionnaire (GHQ; Goldberg and Hillier, 1979), an instrument similar to the SCL-90. In most instances, only total scores, reflecting overall psychological distress, were reported.

Findings. Two of the four large-sample studies did not present analyses that examined links between stress exposure during the war and subsequent experience of mental health symptoms, other than PTSD (Stretch et al., 1996a, 1996b; Wolfe et al., 1996). For example, although Stretch et al. (1996b) assessed both stressors and psychological distress, no data examining the link between the two were presented. The third study, the Iowa study (Iowa Persian Gulf Study Group, 1997), found no link between self-reported psychological stressors and depression, but did not report analyses concerning other mental health problems measured in the study.

In contrast, the Ft. Devens study (Wolfe et al., 1993), evaluated three major stressor categories (traditional combat-related wartime activities; nontraditional wartime events specific to the Gulf War; and non-war zone, deployment-related experiences in the areas of domestic, vocational, and psychosocial stressors) in a sample of 2344 Persian Gulf War veterans. Stress exposure was assessed using a traditional exposure scale and a newly developed scale designed to assess the fuller range of combat-stress exposure associated with Gulf War service. Multiple regression analyses adjusting for demographic characteristics, rank, prior service, and self-appraised preparedness for combat found a significant positive relationship between stress exposure and psychological distress, as measured by the BSI General Severity Index, a PTSD checklist, and the Mississippi Scale for combat-related PTSD.

Of the 16 smaller studies that examined at-risk populations, six only presented analyses that addressed the association between exposure and symptoms of PTSD (Ford et al., 1992; Sohler et al., 1992; Sutker et al., 1994a, 1995a, 1995b; Unger et al., 1992). As a body, the remaining 10 studies reported mixed support linking stress to other mental health problems. Four studies found stress exposure was related to other mental health symptoms (Brandt et al., 1997, Baker et al., 1992; Deahl et al., 1994; Sutker et al., 1993). One such study reported that soldiers with traumatic physical injury during the Gulf War (verified by records) were significantly more likely than soldiers evacuated for other medical reasons to have Axis I psychiatric disorders (Brandt et al., 1997). Another study (Sutker et al., 1993) compared 215 Army National Guard and Army Reserve troops who were deployed to the Persian Gulf with 60 troops from these same units who were activated but not deployed overseas. The study scored subjects on a seven-item self-report war zone stress scale, dividing them into high- and low-stress groups based on the median split of that scale. The high-stress group had more extreme scores on measures of psychological distress (BDI depression score 8.25, and STAI anxiety score 43.6) than did either the low-stress group (3.7 and 36.1, respectively) or the nondeployed group (5.0 and 38.0, respectively) (p significant at $<.007$).

For three additional studies, the link between stress exposure and mental health problems varied as a function of the manner in which mental health outcomes or stress exposure were measured (Labatte and Snow, 1992; Perconte, 1993a, 1993b). For example, reservist survivors of a SCUD missile attack reported greater psychological distress than did members of the same unit who were away from the site of the attack, as measured by the SCL-90 but not the BDI (Perconte et al., 1993a). In a study of troops who engaged in the ground war, sleep disturbance and nightmares after the war were found to be related to personal injury during the war, but not related to exposure to dead bodies (Labatte and Snow, 1992).

Finally, three studies found no significant relationship between stress exposure and subsequent mental health symptoms (McCarroll et al., 1993a, 1995a; Sutker et al., 1994b). For instance, no significant differences in SCL-90 scores (assessing current symptoms 3–5 months and 13–15 months after the war ended) were found between personnel who handled human remains and deployed mortuary workers who did not. In the same sample, however, a difference was found between these two groups in terms of PTSD symptoms 13–15 months after the war (McCarroll et al., 1995a). Stated differently, McCarroll et al. (1995a) found significant between-group differences with respect to symptoms of PTSD but not symptoms associated with other mental health problems. Another study found PTSD to be the only Axis-I psychiatric disorder related to war-zone exposure in a sample of 60 reservists serving in graves-registration duty (Sutker et al., 1994b).

Summary. Although differing in numerous respects, including sample sizes and the operational definition of both stress exposure and mental health, seven of 10 studies focusing on objectively verifiable stress exposure or self-reported combat-related exposure provided at least some evidence of a significant relationship between stress exposure and psychological distress. The strength of these associations, although significant, tended to be modest (e.g., correlations = .06–.27), suggesting that factors other than stress exposure also play a role in determining psychological distress.

GULF WAR-RELATED STRESS EXPOSURE AND BODILY SYMPTOMS

Few studies were designed or reported in a manner that permit firm conclusions concerning the relationship between stress exposure and bodily symptoms that might be due to physical health problems. Many of the studies described above that included the SCL-90 would have been able to provide information about self-reported bodily symptoms had they conducted separate analyses of the somatization subscale, which includes items that measure bodily symptoms (e.g., headache, back and joint pain, nausea, gastrointestinal disorders). However, most of these studies reported only total distress scores on the SCL-90. The latter studies were reviewed in the mental health section above. Nine studies conducted analyses on self-administered checklists of bodily symptoms, such as the SCL-90 somatization scale.

Types of Studies. We again divided the available studies into two types: two large-sample studies and seven smaller studies of populations thought to be particularly at risk for developing adverse health consequences due to stress exposure.

How Health Problems Were Measured. Bodily symptoms were generally assessed by self-report using either ad hoc checklists, the somatization scale of the SCL-90 and its variant the BSI, or the Health Symptom Checklist (HSC; Bartone, Ursano, Wright and Ingraham, 1989). These symptoms may be indicative of an underlying organic cause or may reflect psychological distress.

Findings. Two large-sample studies included measures of health (Iowa Persian Gulf Study Group, 1997; WRAIR 1994/Stretch et al., 1995). The Iowa study (Iowa Persian Gulf Study Group, 1997) found that no single exposure, including stress, was uniquely related to any health problem; but, as described in earlier sections, this study reported that most exposures were related to many of the health outcomes. The WRAIR report (1994) did not include data on the link between stress and bodily symptoms, but concluded (based on unreported data) that bodily health symptoms (as measured in the BSI) were associated with the deployment itself, rather than the stress of combat per se. More recently reported data of primarily army combat units conducted both prior to combat and after return to the States, showed higher bodily symptom scores—as measured by the BSI—for precombat soldiers compared to their own scores after return from ODS (Marlowe, forthcoming), providing evidence that symptoms decreased after deployment.

The seven smaller studies also assessed bodily symptoms, five of which did not report the relevant analyses linking stress exposure to physical health symptoms (Kizer et al., 1995; Sutker et al., 1994a, 1994b, 1995a; Unger et al., 1992). In other words, although these studies included both measures of stress exposure and bodily symptoms, the papers focused on other issues and did not examine the link between stress and health. Mixed results emerged from the two remaining studies. An examination of the relationship between self-reported bodily symptoms and self-reported combat-related exposure found that reserve troops who reported high levels of stress exposure had higher HSC scores than did either the low stress or the nondeployed groups (Sutker et al., 1993). Items on the HSC that were significantly different in the groups could have been manifestations of either psychological or bodily distress (e.g., concentration difficulties, nervousness/tension, and use of medications to sleep or calm down). On the other hand, a study of 249 veterans from the 24th Reserve Naval Mobile Construction Battalion found no link between an ad hoc measure of combat-stress exposure and three factor-analytically derived self-reported symptom clusters purported to represent distinct physical syndromes (Haley and Kurt, 1997). It is difficult to evaluate the claim by Haley and Kurt (1997) that stress was not linked to any syndrome because the authors only reported those associations that were significant at a criterion level of $p < .005$. This study employed a highly stringent significance standard to avoid focusing on chance findings due to multiple significance tests.

Summary. The literature linking stress exposure to bodily symptoms is scant, hampered by methodological limitations, and presents little definitive evidence regarding this question. Some available data attest to a possible relationship between stress and self-reported bodily symptoms, which may or may not reflect an underlying organic etiology.

FINDINGS SPECIFIC TO VULNERABLE GROUPS

As noted in Chapters Two and Four, the scientific literature suggests that certain individuals may be more vulnerable to the potentially negative health consequences of stress by virtue of genetic predisposition, prior history of psychopathology, biological constitution, prior life experiences, or personal (e.g., personality) or social (e.g., social support) resources as well as other factors. Specific to personnel in the Gulf War, several groups were postulated to be at potentially greater risk of stress-related problems. These include CS/CSS units; reservists; persons not assigned to their parent unit; persons who experienced high-magnitude stressors; and various other groups, including female soldiers (see Chapter Three). Demonstration of differential vulnerability requires evidence that groups who experience or perceive similar levels of stress exposure report different levels of health problems, after adjusting for preexisting differences between the groups.

We identified relatively few studies that specifically tested whether the effect of stress on health was greater for any of these hypothesized groups, and those that we identified suffered from methodological problems (summarized in the section below). The literature pertaining to the vulnerability of groups that experienced potentially high-magnitude stress was summarized in the previous sections. Soldiers who reported exposure to stress and traumatic factors were more likely to have developed PTSD symptoms and other psychological health problems, although the relationship between stress and physical disease was inadequately examined.

Four groups of investigators provided information relevant to the vulnerability of female, as opposed to male, Gulf War veterans. In the study by Perconte et al. (1993a), female soldiers on-site during the SCUD-missile attack reported higher scores on the Mississippi Scale for Combat-Related PTSD, the Beck Depression Inventory, and the SCL-90 than did male on-site soldiers. However, the comparisons were of small groups (3 females versus 17 males). In a larger sample of reservists, Perconte et al., 1993b, found that noncombat deployed males and females did not differ on the Mississippi Scale for PTSD, but that combat-deployed females did have higher scores than combat-deployed males in units hypothesized to have experienced significant stress (e.g., the 14th QMU whose barracks were destroyed by a SCUD missile). In studies of the Ft. Devens sam-

ple (Wolfe et al., 1993, 1996), women with high Laufer combat scores reported higher symptom scores on the BSI than did men with similar Laufer combat scores.

Similarly, women soldiers who witnessed death and reported more "hassles" (i.e., low-magnitude stressful events) also had higher Mississippi PTSD scores than did male soldiers who reported the same stressors. Sutker and colleagues (1993, 1995a) found no differences between male and female reservists in the effect of war-zone stress on self-rated symptoms of anxiety or depression. Women, however, reported more physical symptoms on a health-symptom checklist than did men, irrespective of service in the Gulf. Similarly, Engel et al. (1993) found no differences between men and women in the influence of combat exposure on PTSD symptoms in a study of help-seeking Desert Storm veterans. Thus, the differential vulnerability of female, as opposed to male, Gulf War veterans has not been clearly established.

Although no data bear specifically on whether combat support or combat service support units actually reported greater stress-related problems, these units were frequently composed of reservists. A few studies compared reservists to regular military personnel to determine whether different patterns of health problems emerged for the two groups. Assessing the two groups retrospectively—and five years after service in the Gulf—the Iowa Persian Gulf Group (1997) found, in particular, that National Guard/reserve personnel differed from active-duty personnel with respect to symptoms of chronic fatigue, alcohol abuse, and poorer mental well-being as measured by scores on the SF-36 mental-health composite. No other differences emerged between these two groups. Stretch and colleagues (1996; also see WRAIR, 1994) reported results showing that deployed active-duty and reservist personnel had similar BSI scores two years post-ODS, although reservists in the Pennsylvania/Hawaii sample had higher risk of PTSD than did the active-duty population. Neither study addressed whether these differences were attributable to stress by itself or whether the differences might have predated service in the Gulf. The limited available data suggest that reservists may have experienced higher levels of both perceived stress and psychological distress.

A few Gulf War studies provided information relevant to determining whether adverse health consequences varied as a function of personal or social resources. For example, Wolfe et al. (1996) examined characteristics associated with the presence of PTSD symptoms 18–20 months after deployment in a sample of active-duty Army troops and found that symptoms were higher in soldiers with more avoidant and passive forms of coping, poorer unit cohesion, and less family cohesion. Sutker et al. (1995b) studied 775 troops deployed to the Persian Gulf to determine if factors such as personal hardiness and coping styles modified the impact of war-stress exposure. They found that soldiers

classified as suffering from PTSD were more likely to have fewer personal and social resources. In particular, these individuals reported less psychological resilience, employed more avoidant rather than problem-focused coping strategies, and were characterized by less-cohesive families and greater dissatisfaction with social support provided by their social networks. Thus, some support exists for the general hypothesis that groups with certain personality styles and levels of social support may have been more vulnerable to the stress of war-zone exposure, although the absence of predeployment data render any firm conclusions problematic. On the other hand, the WRAIR report (1994) observed that greater physical and psychological distress associated with deployment did not differ as a function of post-ODS life stressors or by such tangible resources as job status, finances, and the presence of significant relationships.

A small number of studies assessed whether preexisting life experiences moderated the impact of stress on health problems in Gulf War veterans. In particular, Engel et al. (1993) found that female soldiers who reported precombat histories of sexual and physical abuse experienced greater stress-related PTSD symptoms than did females who did not, even after adjusting for combat-exposure levels. Similarly, studies of inexperienced military mortuary workers showed that these workers exhibited greater anticipatory (McCarroll, Ursano, Fullerton, and Lundy, 1993b, 1995b) and subsequent psychological distress following actual recovery of war dead (McCarroll, Ursano, and Fullerton, 1993a) than did their more experienced counterparts, suggesting that occupational preparedness may soften the shock of exposure to human remains.

LIMITATIONS OF THE EMPIRICAL LITERATURE EXAMINING THE STRESS-HEALTH LINK

Several methodological and conceptual limitations are apparent among these studies. Few were designed to rule out alternative etiological explanations of postwar symptoms. This is particularly problematic because many of the symptoms of stress are nonspecific by nature, and thus may be attributable to multiple etiologies. Although PTSD is perhaps the only disorder that is regarded as uniquely attributable to stress exposure, many symptoms that appear on some self-administered PTSD checklists contain items that might be reflective of health problems other than those due to stress.

Second, virtually all of the studies used self-report symptom inventories, and did not employ diagnostic interviews or laboratory tests to verify the presence of health problems. In addition, many PTSD studies did not document exposure to a traumatic event. Yet, a definitive diagnosis of PTSD requires linkage of symptoms to a specific traumatic event.

Third, much of the research was retrospective in nature, often requiring respondents to recall events and reactions that happened months—or even years—earlier. Assessments in the more recent studies, for example, extended from two to five years after the last troops withdrew from the Persian Gulf in July 1991. Many veterans who feel sick may be more likely to recall experiencing stress or other possible exposures during deployment because perception of illness can affect the recall or interpretation of the events leading up to the illness (Friedman and DiMatteo, 1989). In addition, recall of events may be affected by chronic psychological distress. Respondents may exaggerate the intensity or severity of the recalled event, giving a distorted picture of the relationship between stress and health. In this vein, the study by Wolfe et al. (1996) found that perceived stress levels and psychological distress increased with the passage of time. In another study, recall of whether an individual was exposed to actual stressful events—many of which were likely to have been highly salient and memorable, such as seeing others killed or wounded—varied over time (Southwick et al., 1997). As found in Southwick et al. (1997), this recall problem is particularly problematic insofar as memory is distorted in the direction of recalling exposure to greater numbers of stressful events with the passage of time.

Another problem concerned the manner in which stress exposure was measured. Many studies used ad hoc measures without adequate psychometric validation (e.g., Baker et al., 1992) or used measures originally developed for use with Vietnam veterans (e.g., Perconte et al., 1993a). Although some of these measures were modified for use in the Gulf War, as noted in Chapter Three, they may have been insufficiently sensitive to the low-magnitude stressors connected with Gulf War service.

Finally, the studies were limited with respect to sampling and study participation rates. Few studies employed random sampling, and many studies relied on convenience samples that were often quite small. Strict matching of groups was usually not conducted (an exception is the Iowa Study). The adequacy of comparison groups, when used, was often unknown. When response rate data were reported, rates were variable and, in many cases, quite low. With some exceptions (Iowa Persian Gulf Study Group, 1997; McCarroll et al., 1995a; and Sutker et al., 1993, 1995a, 1995b), tests of differences in characteristics between participants and nonparticipants were not made. Thus, the extent to which results can be generalized to the entire population of Gulf War veterans is unknown. Lastly, although reserve/National Guard personnel comprised only 17 percent of personnel deployed to the Persian Gulf, most studies focused on reserve/National Guard samples. Thus, active-duty military service personnel were underrepresented.

SUMMARY OF THE STRESS-HEALTH LINK

The numerous design problems described above hamper our ability to draw definitive conclusions regarding the causal role of stress in health problems of Gulf War veterans. Nonetheless, existing studies suggest that exposure to stressful events in the Gulf War is associated with increased risk for PTSD symptoms. While overall rates of war-related PTSD were low, usually under 10 percent, higher rates were identified among those who served in front-line infantry, graves registration, or medical units. With some notable exceptions, most studies showed a modest link between stress and other mental health problems. Little evidence is available to link stress to bodily symptoms or actual physical disease, primarily due to the limited research on this topic.

FINDINGS AND CONCLUSIONS

The preceding chapters examined various issues pertaining to the possible role of stress exposure in the health problems experienced by veterans of the Persian Gulf War. This chapter summarizes key findings and presents a synthesis of our review.

WHAT DOES THE GENERAL SCIENTIFIC LITERATURE SAY ABOUT THE NATURE OF STRESS?

The perception of stress is a complex process, involving both the individual and the environment. Whether individuals perceive circumstances as stressful depends upon their own unique life experiences, as well as their personal, social, and biological resources and vulnerabilities. Mere exposure to challenging life circumstances is not sufficient, in itself, to produce stress, but certain events are more likely than others to be perceived as stressful.

Disease and illness are overlapping, but distinct, constructs. Whereas disease refers to diagnosable physical and psychiatric syndromes, illness refers to the subjective experience of poor health. Illness can manifest itself as bodily symptoms stemming from multiple sources—including psychological, physical, and social agents—and may or may not reflect the presence of an underlying disease. The relationship of illness to disease is complex. A person may experience ill health with no underlying disease. Conversely, individuals may suffer from an underlying disease without regarding themselves as ill.

Perceived stress sets in motion an interrelated set of physiological, behavioral, emotional, and cognitive responses aimed at adapting to environmental demands. Although these responses have adaptive short-term benefits, over time they may act in concert with other host and environmental risk factors to increase the likelihood of poor health.

War-zone deployment is associated with exposure to a spectrum of potentially stressful circumstances, ranging from events such as separation from loved

ones to noncombat war-zone events such as harsh living conditions, to combat events such as traditional combat and its often gruesome aftermath. Apart from actual exposure to combat, war-zone deployment is often associated with the perception that oneself or others are at risk of serious injury or loss of life. Although the literature on noncombat exposures associated with war-zone deployment is still emerging, there is increasing recognition that any one of these perceived or actual exposures may contribute to adverse stress reactions. It is not necessary to participate in actual combat to experience stress, nor is it necessary to experience an event of high magnitude.

DOES EVIDENCE INDICATE THAT DEPLOYED TROOPS WERE EXPOSED TO STRESS IN THE GULF?

Available data suffer from limitations including a lack of general applicability to all troops stationed in the Gulf. Nonetheless, the in-theater and postdeployment interview and survey data converge in suggesting that deployment to the Persian Gulf was perceived by many personnel as a stressful life experience. Although potentially stressful exposures were not perceived as stressful by all exposed personnel, data suggest that large numbers of surveyed veterans reported moderate to high levels of stress resulting from exposure to multiple stressful circumstances. Although comparatively few personnel participated in actual combat, deployed service members experienced a wide range of stressful life experiences including—but not limited to—short deployment notice, uncertainty about the mission and length of deployment, harsh and crowded living conditions, long work hours, separation from loved ones and indigenous populations, concern about polluted environmental conditions, fear of missile attack, prolonged anticipation of chemical and biological weapon attack, and indirect exposure to combat and its often horrifying aftermath. Some evidence suggests that reservists may have experienced somewhat higher levels of perceived stress, perhaps owing to differing expectations about military obligations, differing levels of preparedness and training, the rapidity and abruptness of their mobilization, and the manner in which they were assigned to units.

Although many of the hardships and dangers experienced by veterans of the Gulf War were similar to those experienced by veterans of other wars, this was the first war since WWI in which the clear threat of chemical warfare was known by the troops prior to entering the theater of operations; this was compounded by the combined threats of nuclear and biological weapons. Another difference between the Persian Gulf War and many other previous wars is that U.S. troops in the Gulf experienced low casualty rates. It is possible, albeit speculative, that the greater mortality and more severe morbidity associated with other wars may have drawn attention away from, or obscured recognition of the presence of, psychological or physical symptoms such as those experienced in the Gulf.

DOES THE GENERAL SCIENTIFIC LITERATURE UNRELATED TO THE GULF WAR SUGGEST THAT STRESS CAN CONTRIBUTE TO POOR HEALTH?

The empirical literature on exposure to stress provides ample evidence that perceived or actual exposure to stressful events—including combat or war-zone exposure—can contribute to various psychological or physical health problems. Relatively common self-reported reactions to stress include symptoms of depression, anxiety, impaired memory, and concentration difficulties, as well as symptoms of irritability, fatigue, headaches, back and neck aches, gastrointestinal complaints, and breathing difficulty, that may be due to either psychological or physical health problems. More severe forms of mental illness, including depression and PTSD, have also been linked to exposure to stressful events. The onset of problems varies, with some individuals reporting delayed onset of symptoms. In some instances, what appears as delayed onset of symptoms, however, might be more aptly characterized as delayed medical help-seeking. The duration of problems also varies. Although many psychological and bodily symptoms recede with the passage of time, it is not uncommon for symptoms or illnesses to persist long after the stressful event itself has passed.

The available literature also suggests that stress exposure may act as a contributing risk factor for a range of physical illnesses and disease, including cardiovascular disorders, although the strength of the evidence varies depending upon the health problem in question, and associations are typically modest.

With respect to war-zone or combat exposure, a small number of studies suggest that such exposure is associated with self-reported short-term and chronic health complaints and conditions, as well as higher levels of medical help-seeking. On the other hand, little definitive evidence indicates that war zone or combat exposure as such contributes to actual physical disease. In several studies of war veterans in which a relationship between stress exposure and self-reported physical health problems were observed, these findings have not been borne out by objective medical examination.

ARE THE PROBLEMS REPORTED BY CCEP AND VA REGISTRY PARTICIPANTS CONSISTENT WITH THE SCIENTIFIC LITERATURE LINKING STRESS TO HEALTH PROBLEMS?

To date, approximately 70,000 veterans—roughly 10 percent of the total force deployed to the Gulf—have been evaluated in the CCEP and VA Registry programs. These persons have suffered from a broad range of ailments, the majority of which appear to be well-defined medical and psychological conditions. A sizeable subset of these registry participants, slightly less than 20 percent, have

reported symptoms that have eluded traditional medical explanation. The latter figure equals about 2 percent of those who served in the Persian Gulf War.

Deriving conclusions about the possible contribution of stress solely from consideration of the range of conditions suffered by participants in the Gulf War clinical registries cannot be done with any degree of certainty. Although the general scientific literature has implicated stress exposure as a contributing factor in various well-defined conditions, including some health problems experienced by Gulf War veterans, few problems or symptoms are uniquely characteristic of stress exposure. Thus, with the possible exception of PTSD, the stress of Gulf War service cannot be conclusively determined to have played a contributing role merely from the observed presence of these disorders or symptoms.

Similarly, although some of the symptoms reported by those registry participants with ill-defined conditions seem consistent with stress exposure, these symptoms are also consistent with various other possible etiologies. In sum, the possibility that stress may have either contributed to or exacerbated the health problems of some registry participants (and, by extrapolation, some Gulf War veterans) can neither be ruled out nor proven based upon currently published descriptive registry data.

WHAT CAN BE CONCLUDED FROM THE SCIENTIFIC LITERATURE BEARING DIRECTLY ON THE LINK BETWEEN GULF WAR STRESS EXPOSURE AND SUBSEQUENT HEALTH PROBLEMS?

A number of empirical studies have examined the health consequences of Gulf War service. Many of these studies relied exclusively on comparison of deployed and nondeployed troops without actually assessing stress exposure. Although this research generally shows that deployed troops reported more health problems than nondeployed troops, these studies are silent as to whether any detected differences between the deployed and nondeployed groups are attributable to stress, to other possible exposures, or to preexisting group differences.

A small body of studies, however, directly examined the association between Gulf War stress exposure and subsequent health problems in veterans. In the main, available research focused on the relationship between stress exposure and PTSD symptoms, perhaps owing to the importance of this health problem in the last major war, Vietnam. A secondary focus of available research centered on detecting other psychological health consequences of stress exposure. By contrast, we found very few studies that were designed or reported in a manner that permits conclusions concerning the relationship between stress exposure and bodily symptoms. Although a few studies examined the relationship between stress exposure and self-reported bodily symptoms or functional

impairment, we identified no research studies in which stress was adequately assessed that simultaneously attempted to corroborate subjective health complaints with either physical examination or laboratory test procedures.

In general, although hampered by the previously described methodological limitations, the available empirical research on samples of Gulf War veterans indicates that stress exposure was associated with PTSD or PTSD-like symptoms. With respect to other psychological problems, the data were somewhat less conclusive. Still, the majority of studies tended to support an association between stress exposure and psychological distress. For both PTSD and other psychological health problems, the association between stress exposure and health problems was generally modest, but more marked in persons exposed to high-stress (combat-related) conditions. By contrast, little evidence links stress exposure to an increase in self-reported bodily symptoms, in part because of the paucity of research on this topic.

CONCLUDING OBSERVATION

The scientific study of stress and its impact on health has made enormous advances in recent years. Unfortunately, these scientific strides have generally not been accompanied by an evolution in popularly held misconceptions about stress. The societal stigma associated with stress as an explanation of poor health and disease has contributed greatly to the politicized environment that sometimes characterizes public discourse concerning the health problems suffered by Gulf War veterans.

Although it is inappropriate to rely upon stress exposure as a default explanation for the myriad health problems reported by Gulf War veterans in the absence of a thorough review of research concerning all plausible causes, we think it equally inappropriate to assume that stress played no role. To do so would ignore what the scientific literature shows about the relationship between stress and health.

Appendix

**EMPIRICAL RESEARCH CONCERNING STRESS AND BOTH
PTSD AND OTHER (NON-PTSD) HEALTH PROBLEMS**

Table A.1
Empirical Research Concerning Stress and PTSD

Study	Objectives	Sample	Control	Time of Assessment	Exposure Assessment	Methodology	Outcome Assessment	Relevant Findings
Adler et al., 1994	Examined the prevalence of PTSD symptoms following deployment. Examined the relationship between rank and type of trauma exposure and subsequent PTSD symptoms.	German-based U.S. Army combat units exposed to front line combat. Three categories based on exposure: 1=no exposure to dead or wounded; 2=exposed to civilian or Iraqi casualties; and 3=exposed to U.S., Iraqi and civilian casualties. N=4199; No exposure (27%); civilian or Iraqi casualties (37%); U.S. casualties (35%) No gender specified	No	9-10 months post-PGW	Exposure to dead enemies and wounded allies; Unit related stress assessed by reports of stress related to peer and hierarchical support.	Correlational study examining the relationship between rank, degree of exposure, and PTSD symptoms.	IES; PTSD Symptoms Measure (derived from the BSI/IES/DSM-III-R); Exposure Measure assessing unit-related stress	Exposure corr. with IES scores; Those exposed to U.S. casualties had highest IES scores. Main effect for rank, exposure, and current unit related stress for both intrusion and avoidance (IES). Higher rank associated with less severe PTSD symptoms.
Baker et al., 1992 ¹	To evaluate clinical needs of PGW vets in an Ohio VA outreach program.	Personnel in 19 Reserve units within the Central Midwest; Branch not specified. N=325	No	2-5 months post-PGW	Questionnaire assessing war-time stressors.	Correlational study examining the relationship of demographic variables, childhood experiences, and combat exposure to subsequent psychological sequelae.	IES; BSI; MISS (cut off=107); Coping Strategies Inventory; Childhood variables; childhood trauma.	Sig. corr. between child and combat stressors and MISS scores. Ethnicity and child stressors were corr. w/ BSI scores, combat stress. Blacks had higher BSI, IES scores; Childhood stress associated with higher BSI, IES, MISS. No gender differences. 5.9% PTSD.

Table A.1 (continued)

Study	Objectives	Sample	Control	Time of Assessment	Exposure Assessment	Methodology	Outcome Assessment	Relevant Findings
Brandt et al., 1997	Examined the relationship between physical injury during PGW and psychiatric symptoms.	Service members admitted to Army Medical Center from the PGW/68% traumatic injury; 3 categories created based on presence of psychiatric symptoms: a) full psychiatric diagnosis (disorder); b) symptoms of a psychiatric disorder; c) no psychiatric disorder or symptoms. M=139 F=22	Yes 51 of 161 who experienced non-trauma procedures	During PGW	Admitted to Medical Center for traumatic incident during PGW. (68% traumatic injury, no definition specified)	Correlational study examining the relationship between physical injury and psychiatric symptoms.	Medical records used to establish chart diagnosis and psychiatric symptoms.	36% had psychiatric symptoms; 21% had Axis I disorder; 5% adjustment disorder; 4% PTSD; Patients who experienced greater traumatic exposure were more likely to have psychiatric symptoms.
Deahl et al., 1994	Examined the effects of psychological debriefing following a trauma (PGW) on subsequent morbidity.	British soldiers serving in Army War Grave Service in the PGW. N=42 trauma subjects	Yes N=20	9 months post-PGW	Recovering and identifying dead bodies of allies and enemies	Between-group study comparing debriefed and non-debriefed subjects on morbidity 9 months following return from PGW.	IES; GHQ	50% reported debriefing as helpful. No difference between debriefed and nondebriefed on GHQ or IES scores; Difference in "caseness" (GHQ>5, IES>12), and change in close relationships. Positive corr. between "caseness" and perception of life threat.

Table A.1 (continued)

Study	Objectives	Sample	Control	Time of Assessment	Exposure Assessment	Methodology	Outcome Assessment	Relevant Findings
Engel et al., 1993	Examined the relationship between precombat sexual/physical abuse and postcombat PTSD symptoms.	U.S. Army's First Cavalry Division; Active duty. M=269 F=28	No	4-10 months post-PGW	Precombat exposure as assessed by interview; CES	Correlational study examining relationship between precombat abuse and post-combat PTSD symptoms.	MISS-ODS; CES; DIS Interview	M reported sig. more combat exposure and F reported sig. more precombat abuse. F, but not M, with precombat abuse reported sig. greater PTSD symptoms than those with less precombat abuse. F reported sig. higher MISS-ODS scores. Sig. corr. between CES and MISS-ODS.
Ford et al., 1992 ¹	Compared debriefed versus nondebriefed PGW vets on psychological sequelae following PGW.	Eight Reserve units and National Guard units returning from ODS to V.A. services in Oregon. Branch not reported. N=55 No gender specified.	No	4-9 months post-PGW	Interview assessing war-time stressors. Variables included: family separation, direct exposure, indirect exposure, and emotional stress.	Correlational study examining vets on post-PGW physical and psychological symptoms. Examined change in symptoms after debriefing.	IES; GHQ; Marital Satisfaction Global Rating	75% of entire group reported post-PGW stress and personal and family adjustment difficulties. Post-debriefing reported sig. decrease in PTSD symptoms, anxiety, depression, and social dysfunction and a sig. increase in family functioning.

Table A.1 (continued)

Study	Objectives	Sample	Control	Time of Assessment	Exposure Assessment	Methodology	Outcome Assessment	Relevant Findings
Haley & Kurt, 1997	Examined the psychological and physical symptoms reported by vets following the PGW.	Members of the 24th Reserve Naval Mobile Construction Battalion. 58% retired from service; 42% still active. N=249	No	3 yrs/7 months post-PGW	Booklet measuring war-time exposure	Descriptive study examining the prevalence of health problems in PGW vets. Factor analyzed reported symptoms.	Standard survey measuring symptoms, war time exposure, and psychological distress (scales included Anxiety, PTSD, somatic Symptoms, Health concerns).	70% reported serious health problems attributed to war; six medical syndromes surfaced explaining 70% of variance. Traumatic stress subscale was not elevated in any group of vets with the reported medical syndromes.
Iowa Persian Gulf Study Group, 1997	Compared deployed and nondeployed vets self-report of symptoms and illness 5 yrs following PGW.	Stratified sample drawn from 4 study groups (PGW regular military, National Guard/Reserve, non-PGW regular military, and non-PGW National Guard/reserve). Sample stratified for age, race, sex, rank, and branch. N=3695 M=91% White=91% Age < 25=91%	Yes N=1799	5 yrs post-PGW	Military Exposure Questionnaire; deployment as proxy	Between-group study comparing deployed versus nondeployed military personnel on post-PGW psychological symptoms. Not deployed to PGW as a control group. Stratified random sample with proportional allocations.	PCL-MIL (cut off 50); BSI; PRIME-MD; CAGE	PGW military personnel sig. more PTSD, depression, chronic fatigue, cognitive dysfunction, bronchitis, asthma, fibromyalgia, alcohol abuse, sex discomfort than nondeployed PGW military personnel. National Guard/reserve reported more chronic fatigue and general health problems than regular military.

Table A.1 (continued)

Study	Objectives	Sample	Control	Time of Assessment	Exposure Assessment	Methodology	Outcome Assessment	Relevant Findings
McCarroll et al., 1993a ²	Examined the prevalence of PTSD symptoms in PGW vets who handled human remains versus PGW vets who did not.	116 vets who handled remains were from Army Mortuary Affairs Co. The 118 vets who did not handle remains were from army units handling logistic functions. N=234 Males=84%	Yes M=110 F=8	3-5 months post-return to U.S.	Recovering and identifying dead allies and enemies.	Between-group study examining and psychological symptoms in PGW remains and PGW vets who did not handle remains.	IES; SCL-90-R	Subjects who handled human remains reported sig. more intrusive and avoidance symptoms. Inexperienced workers reported sig. more symptoms than experienced workers. Positive corr. between number of remains handled and PTSD symptoms.
McCarroll et al., 1995a ²	Examined the relationship between handling human remains and subsequent PTSD symptoms.	55 vets who handled remains were from Army Mortuary Affairs Co. The 56 vets who did not handle remains were from army units handling logistic functions. N=55 Male=84%	Yes M=52 F=4	13-15 months post-return from PGW (follow-up)	Recovering and identifying dead allies and enemies.	Between-group design comparing PGW vets who handled remains with PGW vets who did not handle remains on psychological symptoms post-PGW.	IES; SCL-90-R	Sig. differences between groups on IES scores at 13-15 months; Sig. decrease in IES scores at 13-15 mo. Sig. higher IES scores for PGW vets who handled remains. Sig. pos. corr. between age and intrusion symptoms for exposure group.
Perconte et al., 1993a	Examined stress level in survivors of a missile attack before and after treatment intervention. Compared stress levels with a group of survivors who did not receive treatment intervention.	Quartermaster unit hit by missile. N=25 Reserve troops Male=84%	Yes N=8	During PGW (2 months post-missile attack 4/91)	Missile attack (on site; guard duty; nondeployed)	Pretest and posttest between-group design comparing PGW vets receiving debriefing with PGW vets not receiving debriefing in a unit-based program.	MISS (cut off 107); BDI; SCL-90-R	On-site group sig. higher MISS and SCL-90-R scores; F sig. higher BDI, MISS, SCL-90-R GSI at pre-treatment than M. Sig. reduction in symptoms post-treatment. No change in symptoms for nondeployed post-treatment.

Table A.1 (continued)

Study	Objectives	Sample	Control	Time of Assessment	Exposure Assessment	Methodology	Outcome Assessment	Relevant Findings
Perconte et al., 1993b	Examined war-related psychological distress among PGW vets following PGW.	Community sample of Army, Navy, and Marine Reservists. 126 activated but not deployed; 26 deployed to Europe; 439 deployed to Persian Gulf combat theater. N=581 Male=88% White=91%	Yes N=152	11 months post-PGW	Deployed versus not deployed.	Between-group design comparing deployed PGW vets with nondeployed PGW vets on psychological symptoms following trauma exposure. Examined variables of gender, race, and prior combat exposure.	MISS (cut off 107); BDI; SCL-90-R; Military History Questionnaire	Sig. effect of deployment. No sig. effect of race; Sig. interaction effect of race by deployment for MISS. Gender effect sig. for MISS & BDI. Sig. interaction effect for gender by deployment. F sig. higher scores on MISS. No sig. effect of prior combat.
Sloan et al., 1995a ²	Examined the effectiveness of the Rorschach in detecting acute PTSD symptoms in PGW vets.	Volunteer Marine reservists all identified as having PTSD symptoms during a general post-war debriefing. Troops provided security and protected Iraqi prisoners. No vets had prior psychiatric history. N=30 All male	No	3-5.5 months post-war	No direct combat; Some report seeing dead and wounded people.	Correlational study examining the relationship between Rorschach and MMPI-2 scales measures of PTSD.	MMPI-2 (various scales); Rorschach	Neg. corr. between PTSD (MMPI-2) & Rorschach PTSD symptoms and indices of coping ability, personal resources, and psych adjustment.

Table A.1 (continued)

Study	Objectives	Sample	Control	Time of Assessment	Exposure Assessment	Methodology	Outcome Assessment	Relevant Findings
Sloan et al., 1995b ²	Examined the effectiveness of the MISS-ODS in assessing war-related PTSD symptoms in noncombat PGW vets.	Same as Above	No	3-5 months post-war	No direct combat; Some report seeing dead and wounded people.	Correlational study examining the relationship between MISS-ODS scores for PTSD and DSM-III-R criteria for PTSD.	MMPI-2 (various scales); MISS-ODS (cut-off 89)	Of the 17 DSM-III-R PTSD symptoms vets reported an avg of 3.33 symptoms. 4 PTSD pos. according to DSM. 3 of these 4 met MISS-ODS cut-off for PTSD. Pos. corr. between MISS-ODS and PTSD symptoms.
Sloan et al., 1996 ²	Examined the effectiveness of MMPI-2 scales, and the IES in detecting PTSD symptoms in non-combat PGW vets.	Same as Above N=66 All male	No	3-5 months post-war	No direct combat; Some report seeing dead and wounded people.	Correlational study examining the relationship between MMPI-2 scale elevation and elevation on IES.	MMPI-2 (various scales); IES; WSI-ODS (War Stress Interview-ODS)	71% experienced 1 or more symptoms of acute PTSD for at least 1 mo. post-PGW. MMPI-2 scale scores and IES scores were sig. corr. with PTSD symptoms.
Sohler et al., 1992 ¹	Interim report of ongoing study examining the psychological sequelae on PGW vets following the PGW. Examined variables of gender, deployment, and pre-PGW combat exposure.	National Guard/Reserve units in North Central Florida. Branch not specified. M=397 F=110	Yes	6 months post-PGW	Deployed versus nondeployed; CES.	Between-group design comparing PGW vets deployed and not deployed on psychological sequelae post-PGW. Gender, unit, and combat exposure were also assessed.	IES; Prior war experience; SCL-90-R (GSI scores)	Deployed had higher IES scores than non-deployed; F higher IES scores; Sig. interaction effect for gender by deployment (i.e. higher IES scores for deployed F than M); Experienced vets reported sig. fewer intrusive thoughts; F reported higher symptoms. CES sig. corr. with IES.

Table A.1 (continued)

Study	Objectives	Sample	Control	Time of Assessment	Exposure Assessment	Methodology	Outcome Assessment	Relevant Findings
Southwick et al., 1993 ²	Examined the development of trauma symptoms over time in two reserve units.	New England National Guards randomly selected from medical unit and military police unit. M=65 F=19	No	Two Assessments: Time 1=1 month post-PGW; Time 2=6 months post-PGW	CES	Longitudinal study examining symptom severity over time in two reserve units. Examined effects of gender and unit status.	MISS (cut off 89); 17-item PTSD Symptoms Scale; DSTQ (Desert Storm Trauma Quest.)	MISS=3 PTSD pos. at 1 mo/4 PTSD pos. at 6 mo.; PTSD Scale criteria=8 PTSD pos. at 1 mo/7 at 6 mo. Pos. corr. between scores on MISS, CES, & DSTQ. No unit or gender differences. Increase in MISS but not PTSD scale symptoms over time.
Southwick et al., 1995 ²	Same as Above	Same as Above M=49 F=13	No	2 year follow-up (2 yr/1 month post-PGW)	CES	Longitudinal study examining symptom severity over time in two reserve units. Examined gender and unit effects. Compared medical and police units.	MISS (cut off 89); 17-item PTSD Symptoms Scale (DSM-III-R); DSTQ (Desert Storm Trauma Quest.)	At 2 yrs MISS=6 PTSD pos/DSM=8 PTSD pos. Medical unit had higher symptoms. Hyperarousal higher at all 3 time points. Increase in intrusive memories and reactivity between 1 mo. and 2 yrs. Decrease in irritability between 6 mo. and 2 yrs. No gender differences. CES sig. corr. with PTSD symptoms.

Table A.1 (continued)

Study	Objectives	Sample	Control	Time of Assessment	Exposure Assessment	Methodology	Outcome Assessment	Relevant Findings
Stretch et al., 1996 (also Marlowe et al., 1994)	Examined the prevalence of PTSD symptoms in active and reserve deployed PGW vets and active and reserve nondeployed PGW vets following PGW.	Active duty and reservists from PA and Hawaii who were assigned to Army, Navy, Air Force & Marines. Subjects were either deployed (1524; active 715; reserve 766) or not deployed (2512; active 1576; reserve 948) to ODS.	Yes N=2512	Mail survey; 2 years post-PGW	Deployed versus nondeployed. Self-report of stressors.	Between-group design examining prevalence rates of PTSD symptoms in active versus reservists, and deployed versus nondeployed to PGW.	IES; BSI; 17-item PTSD algorithm derived from IES and BSI	Active duty=57 deployed subjects PTSD pos. (8%) /21 of nondeployed PTSD pos. (1.3%); Reservists=70 deployed PTSD pos. (9.2%)/20 nondeployed PTSD pos. (2.1%). Sig. corr. between stressors and PTSD symptoms.
Sutker et al., 1993	Examined the relationship between war stress and physical and psychological symptoms following PGW in activated deployed and nondeployed troops.	Gender not specified. Army National Guard and Army Reserve. Troops were distributed across air reserve, medical, and infantry support specialist, air ambulance, tactical fighters, maintenance, and quartermaster. N=215 M=82% F=18%	Yes N=60	4-10 months post-ODS	ODS-SES (divided groups into high and low exposure).	Between-group design comparing deployed (high and low exposure) with nondeployed (no exposure) on variables of post-ODS psychological sequelae. Compared PTSD pos. with PTSD neg. on personal characteristics.	BDI; STAI; ODS-SES; HSC; MISS (cutoff 97); PCL-MIL (PTSD checklist-military version)	High exposure group reported sig. higher MISS, PTSD Scale, BDI, anxiety and anger scores than did low and no exposure groups. High-exposed group sig. more difficulties sleeping, concentrating, nervousness. Gender and race sig. corr. with PTSD.

Table A.1 (continued)

Study	Objectives	Sample	Control	Time of Assessment	Exposure Assessment	Methodology	Outcome Assessment	Relevant Findings
Sutker et al., 1994a	Examined the psychological, physical, and psychiatric disorders in Army reservists who served war-zone grave registry duty in support of ODS.	Army reservists of the 35th Member Army Reserve Quartermaster. M=21 F=3	No	8 months post-return from PGW	ODS-SES; Open-ended assessment of most severe trauma experienced at ODS.	Descriptive study examining the prevalence of psychological, psychiatric, physical symptoms in army troops who dealt with remains 8 months after return from war.	Questionnaire assessing physical, psychological, psychiatric variables; BDI; SCID; Physical Symptoms Checklist; Anxiety-State; State-Anger (STAS). PTSD diagnosis based on DSM-III-R (SCID).	46% PTSD pos.; 91% of PTSD pos. were clinically depressed (BDI>10); 85% of nonPTSD were not clinically depressed. All PTSD pos. had elevated physical symptoms; 77% of nonPTSD had minimal concern about physical symptoms.
Sutker et al., 1994b	Examined and compared psychological and physical symptoms post-PGW in PGW vets who were deployed to graves registry with PGW vets who remained stateside.	Army Reservists assigned to 3 quartermaster co. that provided supplies and logistic support; 40 were deployed to graves registry. N=60 Female=8% Hispanic=98%	Yes N=20 M=95%	12 months post-ODS	Graves Registry Duty Scale; deployed versus nondeployed.	Between-group design comparing PGW vets deployed to graves registry with PGW vets remaining stateside on post-PGW psychological sequelae.	BDI; STAS; STAI; SCID; Physical Symptoms Checklist; Graves Registry Duty Scale; MISS-ODS(cutoff 97).	Exposure group reported more current and lifetime psychiatric disorder than nonexposure group. Exposure group greater PTSD symptoms, higher BDI, STAS, STAI, & physical symptoms checklist scores. 53% of PTSD cases had concurrent psychological disorder.

Table A.1 (continued)

Study	Objectives	Sample	Control	Time of Assessment	Exposure Assessment	Methodology	Outcome Assessment	Relevant Findings
Sutker et al., 1995a ²	Examined and compared the prevalence of psychological symptoms among military participants in war-zone exposed and stateside duty. Examined gender and ethnicity between exposed and nonexposed.	PG war-zone exposed (n=653) and stateside duty troops (n=259). Included Army, Air Force, Marine, National Guard, and reserve units who underwent psychological debriefing post-PGW. N=912 Female=13% White=63%	Yes N=259 M=83% F=17%	within 12 months post-PGW	ODS-SES	Between-group study comparing war-zone exposed and stateside duty on psychological symptoms post-PGW. Examined gender and ethnicity.	BDI; STAI; STAS; BSI; HSC; MISS-ODS (cutoff 97)	Sig. more depression, anxiety, and somatic complaints for deployed; Minority sig. more symptoms of depression; F sig. more somatic complaints. No main effect for gender and PTSD; Interaction effect gender by ethnicity for PTSD. 10-12% deployed PTSD pos.
Sutker et al., 1995b ²	Examined and compared PTSD pos. and PTSD neg. subjects on the availability of personal and environmental resources.	Troops assigned to Marine, Air Force, Navy, Army Reserve, and National Guard units deployed to combat in PGW. Sample derived from 1432 troops deployed as part of ODS who underwent psychological debriefing within 1 year of return. N=484 M=88% F=12%	Yes N=97 M=87% F=13%	within 12 months of return from PGW	ODS-SES	Correlational study examining PTSD pos. vets with PTSD neg. vets on personal and environmental resources available.	BDI; SCL-90-R; MISS-ODS(cutoff 97); SSQR; WOC	PTSD pos. vets reported sig. less satisfaction w/ social support, less family cohesion and expressiveness, more avoidant coping, self-blame, and wistful thinking than PTSD neg. vets. No gender info specified.

Table A.1 (continued)

Study	Objectives	Sample	Control	Time of Assessment	Exposure Assessment	Methodology	Outcome Assessment	Relevant Findings
Unger et al., 1992 ¹	Examined and compared PGW vets with National Guard vets who remained in U.S. on post-PGW psychological symptoms.	PGW vets following return to Rhode Island from deployment to Persian Gulf and National Guard Servicemen (NGS) who remained in U.S. N=85	Yes N=51	Upon return to Rhode Island from Persian Gulf; time not specified	CES; deployment as proxy	Between-group design comparing deployed and nondeployed reserve personnel on post-PGW psychological sequelae.	CES; SCL-90; MISS-ODS (cut-off 89).	Differences between NGS and PGW vets on CES, MISS, SCL-90-R (7 of 9 scales). Of the PGW vets, 50% under enemy fire saw someone killed; 75% felt in danger of being killed. Of PGW vets, 50% moderate-severe intrusive thoughts and avoidance and 35% nightmares.
Wolfe et al., 1993 ²	Examined the relationship between gender and psychological outcome following exposure to war-zone stress.	PGW vets N=2344 Female=8% White=84% Mean age=30	No	5 days following return from PGW	Survey (traditional wartime activities; nontraditional wartime activities; non-war-zone deployment experiences); Laufer combat and ODS exposure scales; self-generated categories.	Correlational design examining the relationship between exposure, gender, demographics and subsequent psychological symptoms post-PGW.	Ft. Devens ODS Reunion Survey (exposure; psych. and physical symptoms); MISS (cut-off 89); BSI; Demo; DSM criteria.	F 9%, M 4% PTSD (MISS>89); F reported higher MISS, GSI PTSD check list. No gender differences for exposure. Gender, demo. (educ, marital status), Laufer exposure scores, ODS factor scores explain 12-17% of variance on (BSI, GSI, PTSD, MISS) outcome measures.

Table A.1 (continued)

Study	Objectives	Sample	Control	Time of Assessment	Exposure Assessment	Methodology	Outcome Assessment	Relevant Findings
Wolfe et al., 1996 ²	Examined vets response to deployment during ODS.	PGW vets Time 1: M=2136 F=208 Time 2: M=1687 F=162	No	Two Assessments: Time 1 = within 5 days of return; Time 2 = 18-20 months post-deployment.	Same as above	Longitudinal study examining the prevalence of PTSD symptoms over time in PGW vets.	Same as above	No gender differences for exposure; F. higher MISS; 30% in clinical sig. range on BSL. Increase in report of exposure and PTSD symptoms from Time 1 to Time 2. Exposure, gender, avoidance, social support, and family cohesion explain 15% of variance in PTSD symptoms.

¹In Rosenheck, Robert, et al., Returning Persian Gulf Troops: First Year Findings, West Haven, Connecticut: Department of Veterans Affairs, March 31, 1992.

²Data presented on the same sample.

Table A.2
Empirical Research Concerning Stress and Other (Non-PTSD) Health Problems

Study	Objectives	Sample	Control	Time of Assessment	Exposure Assessment	Methodology	Outcome Assessment	Relevant Findings
Baker et al. ¹ (1992) VA Report, Chap 7	To evaluate clinical needs of PGW vets in an Ohio VA outreach program.	Convenience sample; N=325; Reserve and Guard troops; All services: male=74% white=87% response rate=66%	No	2-5 months post-PGW	Self-report survey of military and PGW experiences.	Cross-sectional survey; Needs assessment.	IES; BSI; MISS	Combat-exposed troops experienced higher levels of distress on BSI, MISS and intrusion subscale of IES.
Brandt et al. (1997)	To examine psychiatric problems of PGW surgical patients evacuated from theater for combat and noncombat-related problems.	N=161; All services: male=88% white=66%	Yes N=51 of 161 who experienced nontrauma-related procedures.	During and after PGW	Admitted to medical center for traumatic incident during PGW.	Medical records used to establish diagnosis.	Frequency of Axis I Psychiatric Disorders	Trauma associated w/greater likelihood of Axis I disorder.
Ford et al. ¹ (1992) VA Report, Chap 10	Evaluation of psychosocial debriefing program for PGW vets and families.	N=55 help-seekers; Guard and Reservists: male=70% age=23-55 N=40 PGW vets, others deployed elsewhere.	No	4-9 months post-PGW	War Stress Interview; Self-report.	Cross-sectional survey; Self-report before and after debriefing.	IES; GHQ; Marital satisfaction and family relations.	Symptoms appear to abate after debriefing; No differences in GHQ or IES between troops deployed to ODS or Europe. Slightly higher IES due to readjustment stressors rather than ODS stress.

Table A.2 (continued)

Study	Objectives	Sample	Control	Time of Assessment	Exposure Assessment	Methodology	Outcome Assessment	Relevant Findings
Deahl et al. (1994)	Examined the effects of psychological debriefing following a trauma (PGW) on subsequent morbidity.	British soldiers serving Army war grave service; N=62	Yes 20 of 62	9 months post-PGW	Recovering and identifying dead bodies of allies and enemies.	Between-group study comparing debriefed and nondebriefed on morbidity.	GHQ	No difference on GHQ scores between debriefed and nondebriefed; Health problems more likely in those who perceived a life threat.
Haley and Kurt (1997)	To determine whether symptoms can be explained due to multiple chemical exposures.	Convenience sample; N=249; Reserve construction battalion; male=100% response rate=unknown	No	11/94 3 years/7 months post-PGW	Self-reported exposure to various risks and self-reported symptoms of cognitive impairment.	Self-reported survey of exposure and symptoms; Factor-analyzed reported symptoms.	Self-reported symptoms	Combat stress not related to 3 syndromes; Symptoms linked to other exposures.
Iowa Persian Gulf Study Group (1997)	To compare prevalence of self-reported problems in deployed and nondeployed vets.	Stratified random sample of 3695 active, reserve, and Guard troops: male=91% white=91% age <25=91% response rate=76% all from Iowa	Yes N=1799 M=91% F=9%	5 years post-PGW	Deployment; military exposure quest.	Epidemiologic study; self-reported.	Prime-MD; CAGE; BSI; PTSD-Checklist; SF-36	Deployed had higher prevalence of selected mental and physical health symptoms and syndromes; Reservists more chronic fatigue and alcohol abuse than regular military; Most PGW exposures related to medical and psychiatric conditions.

Table A.2 (continued)

Study	Objectives	Sample	Control	Time of Assessment	Exposure Assessment	Methodology	Outcome Assessment	Relevant Findings
Kizer et al. (1995)	To assess nature of symptoms reported by a National Guard unit that included personnel w/unexplained symptoms.	Unit w/high rate of unexplained symptoms; N=59; male=90% age=23-59 (mean 39) response rate=36%-78%	Yes; N=3927 Some from same unit, others from similar units.	12/94-3/95	All served in PGW; self-report measure of various exposures.	Comparison of those experiencing symptoms w/vets from same and other units.	Standardized interview and physical exam; 13 chronic symptoms.	Target group reported symptoms of non-specific origin; No organic cause detected; 5 of 13 symptoms were significantly greater in target group: chronic diarrhea, other GI complaints, concentration problems, trouble finding words, fatigue. Exposure data not presented.
Labatte and Snow (1992)	To assess psychological impact of exposure to intense "friendly fire" incident during PGW.	Targeted sample; N=56; Active-duty Army troops involved in ground war	No	9/91 4 months post-PGW	Self-reported combat exposure.	Self-report survey	17-item checklist of symptoms; primary focus on sleep disturbance, alcohol use.	29% still had nightmares and 38% reported increased alcohol use; Personal injury more important than exposure to dead soldiers in contributing to adjustment problems.
McCarroll et al. (1993a)	To see if exposure to human remains was related to elevated PTSD scores.	N=234 males=84%	Yes (118 of 234) Deployed but did not handle human remains.	3-5 mos. post-PGW	Handled remains in Gulf War.	Comparison of two groups.	SCL-90-R	No differences in SCL-90-R between groups. Significant differences on IES.

Table A.2 (continued)

Study	Objectives	Sample	Control	Time of Assessment	Exposure Assessment	Methodology	Outcome Assessment	Relevant Findings
McCarroll, et al. (1995a)	To see if soldiers who handled war dead had later symptoms of PTSD	N=55 male=84%	Yes N=56	13-15 months post-PGW	Handled remains in Gulf War	Comparison of two groups.	SCL-90-R	No differences between groups in SCL-90-R. Significant differences on IES.
Perconte (1993a)	To evaluate treatment of intervention for survivors of missile attack.	Quartermaster unit hit by missile; N=25; reserve troops: male=84% response rate=80%	Yes N=8 of 20	3/91-4/91 2 months post-missile attack	On-site during missile attack; War stress survey	Treatment w/control group and pre-post between-group design.	BDI; SCL-90-R	On-site group had greater SCL scores pre-treatment, but not depression. Exposure severity linked to greater distress.
Perconte (1993b)	To examine level of psych. distress among PGW veterans.	Convenience sample; N=581; Army, Navy, Marine Reservists: male=88% white=91% response rate=95% 126 activated but not deployed; 26 deployed to Europe; 429 deployed to PGW	Yes	11 months post-PGW	Military History Quest; units rank ordered by war-stress exposure	Comparison of deployed and nondeployed troops.	BDI; SCL-90-R (GSI)	Distress higher among deployed. Among deployed, distress higher among females; No race effects; GSI and MISS but not BDI scores increased w/war stress rank order (units with more combat stress).
Sohler (1992) ¹	To assess the psychological sequelae of PGW service; Examined gender, deployment, and pre-PGW exposure.	N=507; Reserve and Guard troops: female=21% N=288 PGW deployed N=199 not activated	Yes	7/91-9/91 6 months post-PGW	Deployed versus nondeployed; CES	Between-group design comparing deployed and nondeployed vets on health and self-reported psych./physical health symptoms.	SCL; IES	Deployed report higher IES than not deployed; No differences on SCL-90-R.

Table A.2 (continued)

Study	Objectives	Sample	Control	Time of Assessment	Exposure Assessment	Methodology	Outcome Assessment	Relevant Findings
Stretch et al. (1995) ² (also Marlowe et al. 1994)	Examined self-assessed physical health of PGW veterans.	Active duty and reservists from PA and HI; included all services: deployed=1524 nondeployed=2512	Yes	2/93-8/93	Deployment; Self report of stressors	Cross-sectional survey; Self-report	Checklist of physical symptoms	Deployed troops reported more physical health complaints even after adjusting for demographics.
Stretch et al. (1996) ² (also Marlowe et al. 1994)	Examined self-assessed psychological health of PGW veterans.	Active duty and reservists from PA and HI: deployed=1524 nondeployed=2512	Yes	2/93-8/93	Deployment; Self report of stressors	Cross-sectional self-administered survey of psychological symptoms	BSI; IES	Higher BSI (4%) among deployers; Relationship is weak with control for demographics.
Sutker et al. (1993)	Examined relationship between war stress and physical/psych. symptoms following PGW in activated deployed and nondeployed troops.	Convenience sample; N=215; Army National Guard/reserve troops	Yes N=60 of 215	4-10 months post-PGW	ODS-SES	Between-group design comparing deployed (high and low) w/nondeployed on psych. and physical health measures.	BDI; STAI; Trait Anger Scale; HSC	Deployed w/high exposure had higher depression, anxiety, and physical health complaints than nondeployed; Deployed w/low exposure report symptom levels more comparable to nondeployed.
Sutker et al. (1994a)	Examined psychological, physical, and psychiatric disorders in Army Reservists who served grave registry duty in PGW.	N=24; Army Reservists assigned to Quartermaster unit: male=21 female=3	No	8 mos. post-PGW	ODS-SES	Descriptive study examining prevalence of self-reported health problems and diagnosed psychiatric disorders.	BDI; STAI; Trait Anger Scale; HSC; SCID	Body handlers had elevated physical and psych. symptoms relative to civilian norms; 55% diagnosed w/current Axis I disorder.

Table A.2 (continued)

Study	Objectives	Sample	Control	Time of Assessment	Exposure Assessment	Methodology	Outcome Assessment	Relevant Findings
Sutker et al. (1994b)	Examined impact of graves registration duty on psych. and physical symptoms.	N=60; Army Reservists assigned to Quartermaster unit: female=8% Hispanic=98%	Yes N=20 of 60 non-deployed	12 mos. post-PGW	Graves Registry Duty Scale	Between-group design comparing deployed and nondeployed.	SCID; STAI; Trait Anger Scale; BDI; HSC	Deployed body handlers had higher incidence of PTSD and somatic complaints.
Sutker et al. (1995a)	Examined prevalence of psychological and physical symptoms in PGW vets; examined gender and ethnicity in deployed/non-deployed.	N=912; Reserve and Guard vets; All services: female=13% white=63% age=29 (8.4)	Yes N=259 non-deployed	Within 12 mos. post-PGW	ODS-SES	Between-group study comparing war-zone exposed and stateside vets.	BDI; STAI; STAS; HSC	Somatic and psych. symptoms higher among deployed troops; Females significantly more health complaints than males.
Sutker et al. (1995b)	Compared PTSD pos. and PTSD neg. subjects on the availability of personal and environmental resources.	National guard units deployed to combat in PGW. Sample derived from 1432 troops who underwent psychological debriefing within 1 year of return. N=484 M=88% F=12%	Yes N=97 M=87% F=13%	Within 12 months of return from PGW	ODS-SES	Correlational study examining PTSD-pos. subjects with PTSD-neg. subjects on personal and environmental resources available.	BDI; SCL-90-R; MISS-ODS (cut off 97); SSQR; WOC	PTSD-pos. subjects reported sig. less satisfaction w/social support, less family cohesion and expressiveness, more avoidant coping, self-blame, and wishful thinking than PTSD-neg. subjects.
Unger et al. (1992) 1 VA Report, Chap 8	Examined physical and psych. symptoms in deployed and non-deployed troops.	N=85; Reserve and Guard vets; No demographics provided.	Yes N=51 of 85	Upon return to Rhode Island; time not specified	CES; Deployment as proxy for stress exposure.	Between-group design comparing deployed and nondeployed troops.	SCL-90	Deployed troops had significantly higher physical and psych. symptoms except for depression (somatization not clear).

Table A.2 (continued)

Study	Objectives	Sample	Control	Time of Assessment	Exposure Assessment	Methodology	Outcome Assessment	Relevant Findings
Wolfe et al. (1993)	Examined relationship between gender and health outcomes following war-zone exposure.	N=2344; Active duty Army troops: female=8% white=84% age=30 (9.2) all deployed	No	5 days after return from PGW.	Laufer Combat and ODS Exposure Scales; Self-report.	Correlational design examining relationship between exposure, demographics, and symptoms.	BSI; MISS	Combat and ODS scores sign. related to BSI/GSI, MISS and PTSD; self-generated stress categories were not related.
Wolfe et al. (1996)	Explored patterns of readjustment at two time periods post-PGW.	Time 1: N=2344 Time 2: N=1853 response rate=79%	No	Time 1: within 5 days of return to U.S. Time 2: 18-20 mos. after deployment.	Self-report combat exposure.	Same as above	Same as above	30% scored in clinically significant range on BSI at Time 1; Significant correlation exposure and MISS; More health problems in subjects who exceeded PTSD cutoff at Time 2; Combat exposure reports increased over time.

¹ In Rosenheck, Robert, et al., *Returning Persian Gulf Troops: First Year Findings*, West Haven, Connecticut: Department of Veterans Affairs, March 31, 1992.

² Data presented on the same sample.

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